THE

Practical Teacher

A MONTHLY EDUCATIONAL JOURNAL

Edited by JOSEPH HUGHES.

'*Knowledge is proud that he has learned so much,*
Wisdom is humble that he knows no more.'—COWPER.

VOL. IV. No. 11. JANUARY, 1885. PRICE 6D. POST FREE, 7½D.

Hygiene.

BY ALFRED CARPENTER, M.D., M.R.C.P. (LOND.),
Chairman of the Council of the Sanitary Institute.

THE SCAVENGING OF TOWNS—(*continued*).

Dustbins are abominations which should be discouraged as much as possible; the law allows, nay, even insists upon, their being provided. They are necessary evils which our social customs will not allow us to do without. They should only receive dry dust from the fireplace, and on no account should moist articles, such as fish-bones, skins of animals, putrid game, or offal, be thrown into them. They should be placed at a distance from the wall of the dwelling-house, or if people are compelled to use the outside wall of their building, then the latter should be cemented, and rendered waterproof, unless an impervious receptacle is used. Vegetable refuse should always be burnt in the kitchen fire. Animal refuse and bones should not be stored near to or in the house, under any pretence whatever. They are generally thrown into the dustbin for convenience. The bin should be of galvanised iron, as being preferable to wood; it takes up less room than brick, and can be kept quite clean. It should be covered to keep out the rain. Bricks are pervious, and retain putrid germs. The local authority should make arrangement for the bins to be emptied twice a week in hot weather, and once a week in the winter-time.

In most places the cooks will throw objectionable matters into the dustbin, and we have to deal with customs as they are. It would be much better if a moveable pan could be daily emptied. Those who have gardens would do well to keep the dustbin as far away from the house as possible, and instruct the gardener to utilise the refuse in ways which he will know how to make beneficial in his work.

The custom of piling up immense heaps of house refuse, which local authorities indulge in, which contain all the abominations belonging to town dustbins, and which is done in order that the heap may ferment and the animal matter may decompose by putrefaction, is highly injurious. It is also the custom for town councils, etc., to dispose of this refuse to brickmakers. The latter sift the refuse, separating the small pieces of cinder, coal, wood, and other combustible material from the dust. The sifted particles which are separated are called *breeze*, and are preserved to enable the brickmaker to burn his clamp of bricks, by spreading them into layers between the dried brick-shapes. Other materials picked out from the sifting are called *hard* and *soft core*. The ashes are mixed with road-scrapings, and any other sandy or muddy matter which may be at hand. The soft mud is then moulded into brick-shapes, and dried. The clamps are built with layers of breeze, between the layers of moulded bricks, and they are then coated over with a covering of old bricks and mud. The clamp is then lighted, and the most pestiferous odours pervade the neighbourhood until the burning is completed. The bricks thus produced are, probably, about as abominable as it is possible for such things to be. They are guileless of clay. The burning has been scarcely sufficient to drive off all the ammoniacal matters which they did contain; they are excessively absorbent of water, and will take up an immense quantity of rain in wet weather, so that the house will always be damp. They also contain potass salts, which are seen in dry weather to effloresce on the surface of the bricks, and in a few years they will crumble into the dust from which they have been manufactured. It is far better that the refuse from dustbins should be thrown on to a furnace and utterly destroyed, than that it should be utilised for brickmaking. The collection of house refuse should always be made by the local authority, and never given over into a contractor's hands. The object should not be to make money or to save a few pounds in annual expense, but to keep the kitchen and back premises clean and free from nuisance of any kind. A contractor will do that which pays best, and leave the others undone. Breeze ought not to be permitted, unless it is sifted out at once, as soon as the dust is collected. The 'hard core,' as the clinkers, stone bottles, and similar things are called, may be used in road-making; and the 'soft core,' or manurial part of scavenging, should be removed into the country day by day, so that no putrefaction should be allowed to take place until this part is in contact with the earth, to which it should always go as useful manure.

BRITISH MUSEUM

It used to be the custom for most owners to take out the gravel, sand, or clay, or stone (which made up the ordinary foundation of a town) in a building plot, and then stick up a notice that—'*Dry rubbish may be shot here.*' By this means, the hole was filled up again with every kind of abomination without expense to the owner, who then proceeded to build upon the place thus filled up. A house constructed over such a deposit must of necessity be unhealthy; and the custom has caused the deaths of hundreds of innocent people. It is now, however, nearly obsolete: but inspectors and surveyors require to keep their eyes open to prevent the custom being resorted to in bye-ways by unscrupulous landlords. 'Destructors,' 'carbonisers,' and other machines have been patented for dealing with house refuse. There is also a machine in use down the river Thames, which is called 'the devil' or carcase-crusher, which will reduce a dead horse to mincemeat in less than a minute. Large cities must have these machines, otherwise they will be unable to deal successfully with the immense mass of refuse, both animal and vegetable, which daily comes into their hands. It is right to turn these masses of matter to account, but I object to the fat which is collected at some of these depôts being sold to butter manufacturers and turned into 'butterine.' The fat which is collected at these places is only useful for those manufacturing purposes which are unconnected with food supplies, and ought to be so used up as not to make it possible for food dealers to get hold of it.

The Disposal of Slops.—If there is water-carriage for the disposal of excreta, the slops may go into the house drain with the excreta. By slops I mean the waste from baths, kitchen sinks, urinals, etc., exclusive of fæcal evacuations. Slops are said not to be sewage in the strict meaning of the term, but they are really as much sewage as the sewage from a water-closet. If there is a dry system of sewage disposal and no drains, it is the best form to have a flush-tank which is self-acting, such as that constructed by 'Rogers Field,' so that the slop water may be utilised, where a field is available for the purpose. If this cannot be done, then some kind of slop-pail must be used, and the slops emptied, when the pail is full, into some filter-bed. It is wrong to allow such things to go into surface-drains or ordinary water-courses, until they have been filtered. It is easy to arrange something of the kind in an ordinary garden in country places.

Cesspools should not be permitted unless they are constructed at a distance from habitations in a very porous soil, such as chalk, sand, or pervious stone, with intercepting-trap between the house and the cesspool, and the latter ventilated by a lofty pipe of small size, so as to allow of slow escape of foul gases, but not of free circulation of air, the ventilation being simply for the protection of the intercepting-trap. The cesspool should not be cemented and rendered impervious, unless there is risk of contaminating a neighbouring water supply. In this case it is necessary to have the cesspool pumped out very frequently and the sewage utilised at a distance from dwelling-houses by surface irrigation. It is an odious plan, only to be used when no other is possible. Stored sewage will putrefy and lose its true value as a manure, whilst the smell which may arise in its distribution is bad, and is sure to be complained of by the neighbours.

Surface Water.—'The rain to the river, the sewage to the soil' sums up in a very few words the essence of drainage. No place is properly provided with drainage if the surface water is abstracted from the ordinary water-courses and sent into the sewers. The ordinary water-course should, whenever possible, be kept open to the air. It is a mistake to put running water into drain-pipes except in draining agricultural land, but whilst running streams and occasional torrents should run in their ordinary channels in the open air, and be kept free from manifest pollution, thickly-peopled cities must allow the washings of their streets, of their courts, stable-yards, and pavements, to go direct into the sewer. The excreta of animals foul the surface. The first washing after a long period of fine weather is as truly sewage as any sewer can possibly contain. It may be necessary also to allow the rain-water pipes from the roofs of houses to discharge into these channels; but at the same time the advantages which rain-water affords for washing purposes should not be lost sight of, whilst those who keep animals, such as horses and cows, will do well to preserve it for their use. Domestic animals prefer rain-water to hard water for drinking purposes, even when the former is apparently unwholesome from soot and other contaminations, and it is the best for them. I always advise householders to store their rain-water, provided they can do it without making any part of their house or the basement thereof damp. If the rain-water pipes lose into the sewers, they may have intercepting-traps, though these are really useless in long-continued dry weather, and if the ordinary sewers are properly constructed so as not to contain deposit, traps are unnecessary. Unfortunately, very few sewers in any of our large towns are so perfectly constructed as to be free from deposit. If water-pipes are not trapped, care must be taken that the opening under the eaves of the roof shall be in such positions as to allow of the immediate diffusion of any sewer-gas which may pass up it, without that gas being able to find its way into any open window.

House Drains and Sewers.—I entered so fully into the proper construction of house drains in 'Health at School' that I will refer my readers to that volume for information upon these points, premising only that large sewers are objectionable, that six-inch drain-pipes well-jointed, laid with good fall are the best size for common use; they should always be laid upon concrete, unless the original or virgin foundation of the earth is very solid. They should never pass directly through the wall of the main building—that is, they should never pass under any house, but be cut off so that the house-drain may communicate indirectly only, the disconnecting manhole being capable of easy examination. No deposit should ever be allowed to take place in any part of its course. The soil-pipe of the w.c. should always be outside the house, so that the sewer with which it is connected need not pass through the walls. Drain-pipes should always be round; the glazed ware are excellent for the purpose with asphate joints, smoothed off very carefully inside, so as to prevent impediment to the passage of sewage, and each joint should be concreted on the outside. Lead or iron may be used, and in certain positions it may be advisable to use such, but all kinds of drain-pipes should be tested by hydraulic pressure before they are used, so that they may be really impervious to the passage of sewage or sewer air from within outwards, or to the entrance of ground water from

the outside. Four-inch drains may be allowed if all these conditions are complied with, and then four-inch pipes are even better than six inch, but no single house will ever require a larger bore than six inches. As to fall, one in fifty for a four-inch drain, one in sixty for a six-inch, and one in eighty for a nine-inch, will be sufficient, and ensure freedom from deposit if all the connections are correctly made. When surface water enters a sewer or house-drain there should always be a trapped gully over a disconnecting manhole, so that small gravel and other materials may fall to the bottom and be retained and not pass into the sewer. This manhole should have a syphon-trap between it and the sewer, the communication with the latter being at a higher level than the delivery-pipe. The trap should be frequently cleared out and disinfected by being washed out with chlorine water or solution of chloride of lime, if there is any evidence of decomposition in the manhole. It is also important that house-drains should be placed so that they can be easily examined. Every house ought to be provided with a map or plan showing the position of the house-drain, and the point at which it communicates with the public sewer. There should always be an easy means for examining this point. I have been accustomed to test the drains of a house by sending up them a spray of oil of peppermint or sulphur fumes, or even the smoke from burning brown paper. These odours find their way out at those points which allow of the exit of sewer-gases, and defects may be detected in this way.

Main Sewers.—This portion of our subject would require a volume for the purpose of dealing with it properly. It falls more to the province of the engineer than to the surveyor or inspector. I may, however, premise that no main sewer ought to allow of deposit of any kind within its cylinder, and that sewers that are too large are obnoxious, because they cannot be properly cleansed by the sewage itself, a coating of sewage always taking place in the bore of the pipe or culvert at or about the level of the flowing sewage.

(*To be continued.*)

—o—

The Discipline of the Mind.

BY W. C. COUPLAND, M.A., B.SC.,

Lecturer on Mental and Moral Science at Bedford College, London.

VII.—The Formation of Habits and Character.—(*continued.*)

There are two classes of motives which must be relied on both here and there, the self-regarding and the extra-regarding, prudence and sympathy. The system of duty embraces both, for though neither *quâ* feeling is moral, yet as directed to the end of universal well-being, they are both elevated to the rank of the moral motives proper. It is not true, I think, as is commonly supposed, that self-love is something more deep-seated and primordial in our nature than sympathy. On such an assumption is based the idea that we must be content in juvenile training to make the earliest appeal to self-interest, and reserve appeals to disinterestedness to a more advanced stage of rationality. On the contrary, the right training should endeavour from the first to establish an equipoise between the egoistic and altruistic impulses, for which a basis is given in the essential sociality of human nature. It might even be maintained that a keen eye for our own interests is a late development, at least in a large number of instances. The utter disregard of personal well-being, the generosity which oversteps rational bounds, are characteristic of an early period of life, and often as much need the trainer's care in the way of pruning as the feeling for others' good requires prompting. What is true, however, is that both self-love and love of others are at first awakened through vivid sensation and present emotion; and only gradually are called into activity through ideal suggestion. The child cannot be affected by what is remote, by influences which require a high pitch of imagination, or which entail a vast series of not very evident consequences. This is why a corrective discipline must operate by influences which can be immediately felt, by speedy gain and retribution. But none the less must such rewards and punishments be analogous to those which fall to the lot of the mature mind, if this discipline is to have a permanent value. In the life of the world the good and evil effects of conduct are often brought home very indirectly. Retribution is often long delayed, and the path to permanent success is wearisome to a degree. I take it that a true school-discipline should prepare the mind for this, by making the consequences of conduct more and more re-presentative, in conformity with the mental development. Certain and sure, however, the consequences should always be. The whole value of the moral education of the school is that it is a genuine economy, that it saves the wasteful experience of after life. The unreflective mind is apt to question the universality of the Law of Causation, and, long after it is convinced that Nature knows no exceptions, to believe that in the human social world reaping is not united by a necessary tie to sowing. It imagines that there are short cuts to affluence, that there are other ways than the path of duty to true glory, that it is possible to outstrip competitors by well-managed deception, and yet not suffer for it. And, owing to the limitation of human vision, it is undoubtedly true that lucky strokes of successful knavery are sometimes made. But then it is as at a public gaming-table. Lucky throws are possible; but the chances are heavily in favour of the 'bank.' Seeing the mischief that is often done by 'pious frauds,' it might be well to lay before the elder mind the true state of the case; to point out the divergence of the real in human life from the ideal; for veracity, like honesty, is in the long run the best policy. But, although no concealment in the matter is desirable, any harm that might conceivably flow from such a revelation should be easily neutralised by a formed habit, habit which has been engrained by the exceptionless play of cause and effect. The child should always *atone* for its misdeeds, should always reap the reward of its diligence and good behaviour. The breath of favour and disfavour must be immediately felt, and must be wafted with strict impartiality. As is sown so should be reaped. Nothing is so bewildering to a growing mind as a teacher's capriciousness, a deviation from a strict rule of justice. Teachers cannot be free from unforced partialities; lovable natures must exercise their subtle spell, and odious dispositions secretly repel; but in the pupil's presence all scholars must be equal, and like causes must be

followed by like effects, like good or evil deserts be attended by like rewards and punishments. As hinted above this is not strictly in accordance with the experience of mature life, but it is in accordance with the ideal of that life, and one aspect of civilisation is an approximation to such a state of things. The growth of knowledge and of the social feeling is attended with a lessening of caprice.

And so in school training, caprice must vanish—caprice in the apportioning of rewards and punishments, caprice in the kind of rewards and punishments. The former is self-evident; the latter has never been seen so clearly. The reason is plain. The true object of punishment is only gradually dawning upon the general mind. The pristine theory of punishment, which still survives, is that it is an infliction of pain, as penance for the infringement of rights or for contempt of authority, the requital of an affront to the sovereign majesty either of the civil government or the individual. The satisfaction of the feelings of the injured or insulted party is considered the end of the infliction; and, as we know, in rude ages these feelings were estimated according to the social rank of the injured individual, the penalty to be paid for insult to a king, or the crime of high treason, being indefinitely greater than that paid for a similar offence to a more lowly member of the community. This theory may now be pronounced obsolete (not so the practice founded upon it); and it is held that the only legitimate ground of punishment is the prevention of a repetition of the offence, and the only allowable description of punishment that which is reformatory of the criminal. Now, it is found by experience that punishment which has no relation to the offence—that plays the part of a sort of hopeless treadmill, like the aimless labour of the fabled Sisyphus—is simply pain-inflicting, and not reformatory; nay, its effect is frequently indurating, strengthening the evil disposition, and producing stoical indifference. The stock methods of the scholastic Rhadamanthus are flogging, and 'impositions,' or the interminable writing out or committing to memory of the pages of some arbitrarily-selected author, usually a fine classic—to such base uses is the fruit of the world's wisdom often put! As regards flogging, not a word is to be said in its favour. Sensitive natures are crushed by it; in coarser natures a spirit of defiance is aroused, and the embryonic conception of moral law thoroughly materialised. In neither case is there that fruit which is desired, a security for future better doing. The dreary imposition of tasks, which have no aim save that of exacting a pound of weary flesh, is probably doomed to even speedier abandonment.

But, although the folly of these rough-and-ready methods is coming to be seen, there is not always the perception of a truer course. It is not certain that the trainer will obtain a clear insight of this more excellent way. This, however, can be no other than that which is truly reformatory of the disposition which has been shown by the faulty conduct to be perverted. What is required is a readiness to act in a certain manner, a formed habit; and this is only to be brought about by associating the action with its natural consequences, not by so many slaps every time the delinquent is caught. The proper punishment for slothfulness or procrastination is a loss of valued opportunity; for theft restitution and loss of trust; for wanton aggression restraint of liberty; for leze majesty, or contempt of the constituted authorities, social outlawry,—the misery of loneliness through being shunned by the community. When the punishment is natural and not arbitrary the dangerous spirit of rebellion and defiance is cowed. The prophecy is then literally fulfilled that as we mete so is it measured to us; and the delinquent does not feel that he is under the heel of a powerful tyrant, at whose mercy he is, simply because he is weak; but the judge who pronounces the sentence is impersonal, and the decree is not murmured at, because it is felt to be entirely just.

It is by the discipline of the natural consequences of action that the true conscience is formed. My readers well know that in the philosophy of conduct no subject has been more debated than the nature of conscience; it being held to be now simple and primitive, now complex and derived, now progressive and uncertain, now immutable and clear. But it is still held by all parties that it is a universal and inalienable possession, and that it should possess a singular authority. It would be beside my present mark to dilate upon the subject; I will only observe that the universality of 'conscience' points to its being a formal rather than a material principle; that is to say, the actions with which it deals are indifferent to it. As, like the sovereign, it is above the law, it knows nothing of the strifes of parties and particular legislation. Whatever be the accepted moral code of the time and place, its verdict is always the same—*infringement of the law is wrong*, and is felt to be deserving of punishment, punishment which in memory becomes remorse. This being its nature, however, the immense importance of a worthy code can hardly be exaggerated. In the period of pupilage when ordinances are unwise, one of two evils results; either the reason of the pupil rises above the law, and the authority of the law-giver is impugned, or the moral sense is perverted. But these consequences are only too frequent in ordinary school legislation; it is well if the lesser of the two evils, the impugned authority of the law-maker, be the sole mischief.

The substance of morality must be strictly human. By that I mean that the worth of actions must be determined by the consequences to man himself. No other standard is free from all doubtful disputations, and beyond the canker of subtle disbelief. Personal and social well-being is the end and aim of all law, and to prescribe duties out of all relation to this end, or to frame a list of 'sins' which cannot be brought home to the natural sense, is to set about forming a character indeed, but a character which may as easily prove a curse as a blessing. The discipline of the mind, at any rate, finds its terminus here. Man, as a child of Nature, the latest birth of time, standing on the wrecks of ages, surveys the lower life from which he springs, and forecasts a future beyond his own little span; revelling, perchance, in dreams of worlds unlit by sun or star; but, however lofty his imagination, however penetrating his understanding, his rule of conduct can have no wider scope than the welfare of his peers, the beings to whom he owes all he knows, and whose joys and sorrows form the sunshine and shade of his inner life.

Article 106 (*b*).

Merit Grant in Infant Schools.

BY MRS. MORTIMER,

Lecturer on Kinder-garten at the Home and Colonial Training College, London.

Section II.—Phenomena of Nature.

LESSON—THE SUMMER.

CAN you tell me what part of the year we spoke about last week? Yes, the spring. How many months are there in the spring? What are their names? Can you tell me what comes after the spring? The summer. And how long is the summer? Can you tell me the names of the months? What kind of weather do we have? Yes, it is very hot, and we see the sun for a long time. What kind of days would you say we had? The days are very long, and the nights very short. Yes, when you wake up in the morning you see the sun shining, and when you go to sleep at night it is still light.

Are you glad when the summer comes? Yes, we can keep out of doors then. You are able to have all your games in the open air; and the bright weather makes you feel very happy. Your fathers and mothers are also very pleased to see the summer come. They are able to get out into the fresh air after they have finished their work. Can you tell me some of the things we do in the summer-time? Little children go for nice walks in the parks and fields, they run and jump about, and when they are tired they can sit down on the grass without catching cold. Could you do this in the winter-time? No, we have to go indoors when we want to sit down. What do the big boys do? They play at marbles and tops, and also at cricket. If they are near the water they like to bathe in it, for it is not very cold. Men also like to row the boats on the water, and sometimes boys sail their little ships. Then you can go fishing without catching cold. Yes, and there are many other things we do in the summer-time.

Although you can play so much in the open air you must be careful not to get too hot, nor to stand about in the sun without having your hat on, for you are sure to be very ill if you have your head uncovered.

There are other reasons why we like the summer to come. In the summer-time all the things in the gardens and fields grow very fast, and the fruit gets ripe. Can you tell me some of the fruits that grow in the fields and gardens? The apples, pears, plums, cherries. Yes, these all grow on trees. Tell me the names of some that grow on bushes? Yes, currants, gooseberries, raspberries, and strawberries. Well, the raspberries grow on what are called canes, and the strawberries grow on little plants close to the ground. Then we see the corn growing very high, and towards the end of the summer it gets quite ripe. We like to see the golden ears of corn with the sun shining upon them. Can you tell me the name of the corn of which flour is made? It is called wheat. What do we make of flour? It is made into bread. When we see the fields full of good wheat we know we shall have good bread. When the corn is ripe it is cut down, and we say the harvest-time has come. Haymaking should also be referred to.

Then the gardeners are very busy in the gardens. Why? Because the gardens are full of flowers, and they all want looking after. Can you tell me the names of some of the summer flowers? Roses, geraniums, fuschias, marigolds, nasturtiums, sunflowers, sweet peas, mignonette, etc. The warm weather makes these and all other things grow very quickly. Some things, however, which we do not like in the garden give the gardeners a great deal of work. Can you tell what they are? Yes, they are the weeds. Why do we not like them? Because they spoil the garden and prevent the flowers from growing nicely. The other day some little girls told me they had a nice lawn in their garden. What do we call a lawn? A nice plot of grass. Well, what does the gardener have to do to this? He has to cut it very often. Why? Because it grows so quickly in the warm weather.

In the summer-time you have nice long holidays. Where do some of you go then? To the seaside and into the country. The pleasures of the seaside and country should then be slightly alluded to.

Section III.—Scenes of Common Life.

LESSON—THE PARTS OF A HOUSE.

To-day, children, we are going to talk about the different parts of a house, and I want you to tell me the uses of them.

First tell me all the different parts you can think of. The walls, the windows, the doors, the roof, the rooms. That will do. Now, of what are the walls made? They are made of bricks, and sometimes of stone. Of what else are they sometimes made? How many of you have seen wooden houses? Well, then the walls are sometimes made of wood. A little boy says they are made of tin. I think he means of iron. I daresay you have all seen the church not very far from here that is made of iron. That is only put there until the people have enough money to build one of bricks or stone. Why do we build the walls of bricks or stone? To keep out the wet and the cold. Of what other use are the walls? They have to hold the floors, the windows and the doors. Where is the roof of the house? At the top. Of what is it made? Of slates or tiles. Yes, and in the country it is made of straw, etc. We say these kinds of roofs are 'thatched.' Are the roofs generally quite flat? Oh, no, they are slanting. Can you tell me why they are slanting? For the rain to run off. Where does the rain run to? The rain-water runs into the gutters. Where are the gutters? All round the edge of the roof. Yes, and I daresay you have all seen a long pipe running down the wall of the house from the top to the bottom; this pipe carries the water from the gutters into the drains. In the country the people have very large tubs, and the water from the pipe runs into them. This water is very soft and nice for washing. Why do not the people in London do the same? The teacher should briefly explain this to the children.

What do you see on or above the roof? The chimneys. For what are they used? They carry off the smoke from the fires. Where are the fires? Inside the rooms. For what do we use them? To cook our food and to warm ourselves.

When you want to get into the house, what must you do? Wait until the door is opened. When you have entered the house in what part are you? In the passage. Yes, sometimes we call it the hall. What can you see when you are standing in the hall? A number of doors. Where would they lead you? Into the rooms. What else do you see from the hall? The stairs. Where do the stairs lead? To the rooms on the next floor. What do we call the part at the top of the stairs? The landing. If you stand on the landing what do you see? Several doors. What do these open into? Into different rooms. What do you call the stairs leading from the hall to the landing? A flight of stairs. Is there more than one flight of stairs? Yes, there are generally two flights and sometimes more. Well, Mary says there is a flight of stairs in her house leading from the hall down to the kitchen. When you have to go downstairs from the hall to the kitchen, we say the kitchen is in the basement. What do we call the rooms on the first landing? The first floor. And on the second landing? The second floor. So you see in some houses we have a ground floor, a first floor, a second floor, etc.; and then in others we have a floor below the ground floor which we call the basement.

Why do we have doors to our houses and rooms? To keep out the cold and the wet. And for what else? To prevent anybody from walking in when they choose. What do we do when we go out? We lock our doors. Why? So that our house will be quite safe. If we

were to leave our doors open perhaps some persons, whom we should not like, might come in. Tell me what you call those persons? What do you mean by robbers and thieves? Yes, bad people who get into our houses and take our things away.

Then you told me there were windows in the house. Of what are they made? Of wood and glass. Of what use are they? They let in the light, and at the same time keep out the cold and wet. Why are they made to open and shut? When it is warm weather or when the room is too hot we are able to open the windows and let in the cool air, and when the room is cool enough we can shut them again.

Tell me the names of the different rooms in your house, Harry? The kitchen, the sitting-room, and the bed-room. Who can tell me the names of any other rooms? The scullery. Well, Willie? My uncle has a dining-room. Yes, and some people call another room, the parlour or drawing-room. The children might then be asked the use of each room.

Then we must not forget that your mothers like to find nice large cupboards in the different rooms. Why?

Summary.—The children might write on their slates the names of the different parts of the house, and for a further exercise they might say of what they are made, and for what they are used.

Section IV.—Common Employments.

LESSON—THE PORTER.

Now, children, I want you to think of a railway station, and tell me what you can see there. Yes, that is right. Now what men do you see about the station? The porters, the guards, the station-master. Where do you generally see the guard? In the train. How do you know a porter? By the dress he wears. What kind of clothes does he wear? They are of a dark colour, they look thick and strong. On his coat he has rather large buttons, and on his cap there are some letters. Tell me some of the letters you have seen? Harry says he has seen M.R. and D.R. Jack says he once saw G.N.R., and Mary said she saw S.W.R. Well, these letters show which railway the porters belong to. M.R. stands for Metropolitan Railway, D.R. stands for District Railway, and G.N.R. stands for Great Northern Railway. I wonder who can tell me for what S.W.R. stands? That is right, it means South Western Railway. What kind of coat does the porter wear? It is a short one, and it is called a jacket. Do the guards and ticket-collectors wear the same kind of clothes? No, they are made of smooth cloth, and they have long coats instead of jackets. One little boy says the porters wear striped jackets; well, they sometimes do in the warm weather, because their other clothes are so thick and warm.

I want you now to tell me some of the things you have seen the porters doing. They sweep the platforms, pick up the pieces of paper, clean the lamps, and when the weather is hot they sprinkle the platform with water. Why do they do this? To keep the stations cool. But the porters do something else. What do they do when the train comes in? They call out the name of the station very loudly. Why? So that the people in the train may know where they are. The porters also call out where the train is going. And what else? They open and shut the carriage-doors and help the people in and out. Then they have to look after the luggage and see that it is right. How can they tell? They read the papers on it. Yes, we call these papers the labels. If your luggage is too heavy for you, the porters will carry it for you.

You see, then, that the porter has a great many things to do and see to. What kind of man ought he to be? He ought to be quick and strong. Why? Because he has to carry heavy luggage, and the train cannot wait long for him. Then he should be kind and civil. Why? Because he has to help people and tell them where to go. Then he must be clean and able to read. Why? Because he has to look at the labels, and he has to label the luggage when you are starting.

Chemistry of the Non-Metallics.

BY EDWARD AVELING, D.SC. LONDON.

[This series of articles, whilst dealing with the subjects required by the University of London for the Matriculation Examination and with those required at the Elementary Stage of the Inorganic Chemistry (Branch X.) Science and Art Department, is intended as a practical guide to the philosophical and systematic study of the non-metallics.]

CHAPTER V.—HYDROGEN (*continued*).

VALENCY. ICE. WATER. STEAM. LATENT HEAT.

E. MIXTURES.—None is known.

COMPOUNDS. (a) *General.*—Hydrogen combines with every one of the non-metals, except, as far as is known, boron. A list of symbols and names of some of the compounds resulting follows:—

HH. = H^2...	Hydrogen	hydride	or hydrogen (really an element).
H_2O	,,	oxide	,, (water.)
H^3N	,,	nitride	,, (ammonia).
H^4C	,,	carbide	,, (light carburetted hydrogen).
HCl	,,	chloride	,, (hydrochloric acid).
HBr	,,	bromide	,, (hydrobromic acid).
HI	,,	iodide	,, (hydriodic acid).
HF	,,	fluoride	,, (hydrofluoric acid).
H^2S	,,	sulphide	,, (sulphuretted hydrogen).
H^3P	,,	phosphide	,, (phosphuretted hydrogen).
H^4Si	,,	silicide	,, (siliciuretted hydrogen).

From this list two principles may be learnt. Note that one atom of hydrogen combines with one atom of each of the following elements: hydrogen, chlorine, bromine, iodine, fluorine; that two atoms of hydrogen combine with one of each of the following: oxygen and sulphur; that three atoms of hydrogen combine with one atom of nitrogen and of phosphorus; and that four atoms of hydrogen combine with one atom of carbon and with one atom of silicon.

An element 1 atom of which unites with 1 atom of hydrogen = a monad; μονος (monos) = 1.
An element 2 atoms of which unite with 1 atom of hydrogen = a dyad; δύο (duo) = 2.
An element 3 atoms of which unite with 1 atom of hydrogen = a triad; τρεις (treis) = 3.
An element 4 atoms of which unite with 1 atom of hydrogen = tetrad; τεττερα (tettara) = 4.

Thus hydrogen, chlorine, fluorine are monads; oxygen and sulphur are dyads; nitrogen and phosphorus are triads; carbon and silicon are tetrads.

These names, monad, dyad, triad, tetrad, express what is called the *valency* of an element. Some elements, however, do not unite with hydrogen, and their valency has to be determined by noting how many atoms of hydrogen they replace it. Reference to the equation that represents the formation of hydrogen from water and potassium (see page 260) will show that one atom of potassium replaces one atom of hydrogen. H^2O or HHO is the symbol of water; KHO that of potash.

Reference to the equation that represents the formation of hydrogen from zinc and sulphuric acid will show that one atom of zinc replaces two atoms of hydrogen. H^2SO^4 is the symbol of sulphuric acid. $ZnSO^4$ that of zinc sulphate.

Hence the full definition of a monad is an element, one atom of which combines with or replaces one atom of hydrogen; of a dyad is an element, one atom of which combines with or replaces two atoms of hydrogen; of a triad, an element, one atom of which combines with or replaces three atoms of hydrogen; and of a tetrad, an element, one atom of which combines with or replaces four atoms of hydrogen.

There are higher valencies than the four just named. Some few elements act as pentads and hexads. The majority of the sixty-three elements are dyads. If, therefore, a list of the chief monads, triads, tetrads is given, the student will remember that all the elements with which he has to do, not in that list, are dyads.

Monads.

Hydrogen, chlorine, bromine, iodine, fluorine.....Potassium, sodium, silver.

Triads.

Nitrogen, phosphorus, boron.....Arsenic, antimony, bismuth, gold.

Tetrads.

Carbon, silicon.....Platinum, tin.

The second principle to be learnt from the list of symbols and compounds has to do with nomenclature. Only two elements are concerned in each compound represented there, whatever may be the number of atoms of each element present. The name of each compound is a double name. One word of the name is 'hydrogen.' This tells us that the element hydrogen is the positive electric constituent or basylous radicle of the compound. The other word tells us that some other element is the negative electric constituent or chlorous radicle, and this second word always ends in 'ide.' A like method is adopted in naming every compound of two elements. A few more symbols and names are given :—

KCl .....Potassium chloride.
NaBr.....Sodium bromide.
ZnS .....Zinc sulphide.
CO .....Carbon oxide.

Finally, the bulb, F, most to the right, is, at first, empty, and the tube beyond, C, contains calcium chloride. This bulb and tube must also be weighed. Before any heat is applied to the copper oxide, expel all air by a current of hydrogen evolved from the zinc and sulphuric acid. Then apply heat to the bulb, E, containing the oxide. The hydrogen, passing over the red-hot copper oxide, unites with the oxygen of that compound and forms hydrogen oxide, or steam. This condenses in the second bulb or in the calcium chloride tube beyond. Copper is left in the bulb, E, over the flame. Weigh this bulb at the end of the experiment. The loss of weight as compared with the weight before the experiment tells the weight of the oxygen in the water that is formed. Weigh the two last pieces of apparatus, F and G, most to the right. The gain in weight tells us the whole weight of the water formed. The difference between these two numbers is the weight of the hydrogen in the water that is formed. This is the synthetical method of determining the composition of water. συν (sun)=together, θησις (thesis)=a placing. Synthesis is, therefore, the putting together of bodies to form a compound.

No matter how many times this experiment or that of the analysis of water is repeated, the result is the same, if the experiments are conducted with care. Hence we are led to the first great law of chemical combination, that *chemical compounds always contain their components in the same unvarying proportions. This is called the law of constant proportion.*

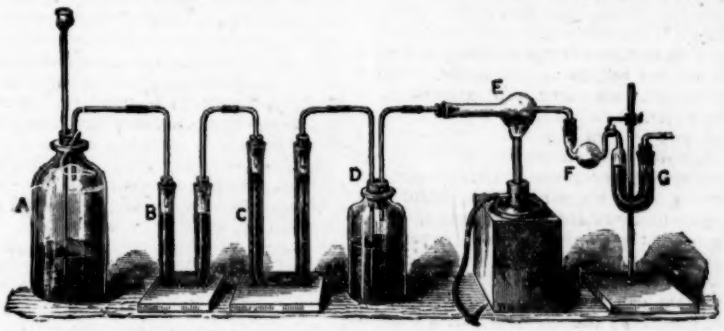


Fig. 16.

Of the long list given on page 494, only the second and third will be studied in connection with hydrogen. The others will be studied under the account of the element that is combined in each case with hydrogen.

(β) *Special. Hydrogen oxide.*—(*a*) *Symbol*, H^2O.
(*b*) *Weight-number*, 18.

(*c*) *Preparation.*—In the form of water this compound is so prevalent that its preparation is unnecessary, save as an interesting chemical experiment.

(1) *Laboratory Method.*—Burn hydrogen. This gas combining directly with oxygen, hydrogen oxide results.

(2) *Symbols.*— $2H^2 + O^2 = 2H^2O$.

(3) *Weight-numbers.*— 4 + 32 = 36.
4 vols. 2 vols. 4 vols.

Another preparation of hydrogen oxide is of interest also as showing the exact composition (by weight) of that compound.

(1) *Laboratory method.*—Arrange apparatus as shown in Fig. 16. The first bottle to the left, A, is one for the evolution of hydrogen by the action of sulphuric acid on zinc. The two succeeding bent tubes are partly filled with calcium chloride ($CaCl^2$). This substance absorbs any moisture that may be mixed with the escaping hydrogen. The fourth piece of apparatus is another bottle containing sulphuric acid. Thus, when the hydrogen gas passes, it is delivered dry and pure into the bulb, E, below the burner. In this bulb is some copper oxide (CuO), carefully dried by heat, and carefully weighed.

(2) *Symbols.*— $Cu\ O + H^2 = H^2O + Cu$.

(3) *Weight-numbers and volumes.*— $\underbrace{63+16}_{79} + 2 = \underbrace{2+16}_{18} + 63$
2 vols.

QUESTIONS ON THE SYNTHESIS OF WATER (*solved*).

46. What weight of copper oxide is necessary for the formation of 36 cc. of water, and what volume of hydrogen must be passed over it?

36 cc. water weigh 36 grams.
18 grams H^2O need 79 grams CuO + 22·4 litres H.
1 gram „ needs $\frac{79}{18}$ gram „ + $\frac{22{\cdot}4}{18}$ „
36 grms. H^2O need $\frac{79 \times 36}{18}$ grams CuO + $\frac{22{\cdot}4 \times 36}{18}$ litres H.
158 grams CuO and 44·8 litres H.

47. 5600 cc. hydrogen are passed over red-hot copper oxide. What weight of copper is left?

22·4 litres = 22400 cc. H. passed over a sufficient quantity of CuO yield 63 grams Cu.
1 cc. H passed over a sufficient quantity of CuO yields $\frac{63}{22400}$ grams Cu.
5600 cc. H passed over a sufficient quantity of CuO yield $\frac{63 \times 5600}{22400}$ grams Cu.
$15\frac{3}{4}$ grams.

QUESTIONS ON THE SYNTHESIS OF WATER (*for solution*).

42. What weight of water will be formed by the passage of 4 grams hydrogen over an unlimited quantity of red-hot copper oxide? .....36 grams.

43. Required a litre of water. What weight of copper oxide, and what volume of hydrogen are needed?

4388⅜ grams; 1244⅛ litres.

This same compound, hydrogen oxide, is formed whenever any substance containing hydrogen as one of its elements is burned. If a bright glass is held over a burning candle or over a paraffin lamp, steam is found to be deposited on it. The tallow or wax of the candle has for one of its constituents hydrogen, and this gas joining with the oxygen of the air forms hydrogen oxide.

(*d*) *Properties.*—Hydrogen oxide exists in three forms—the solid ice, the liquid water, the gas steam.

(α) Ice.—1. *Condition.*—Solid; melting at 0°C.

2. *Effect on the Senses.*—Hard, brittle, tasteless, odourless, translucent.

3. *Specific gravity.*—Lighter than water, with which, like all solids, it is compared. Taking the specific gravity of water as 1 that of ice is ·9175. Hence, when water freezes, expansion takes place. This expansion, when water becomes ice, is the cause of the bursting of water-pipes in houses. The pipes, if full of water, burst when the frost comes, but the discovery of the mischief is made when the thaw sets in, and, the ice melting, the water flows through the flaws. This expansion is also the great agent in the disintegration of rocks. If the crevices of a rock are filled with water when the frost comes, the expansion caused by the water as it turns into ice breaks up the rocks. The lightness of ice as compared with water also explains the fact that ice floats on water.

4. *Solubility.*—Not soluble in water.

5. *Relation to Combustion.*—Not combustible.

6. *Specialties.*—When ice becomes water, a larger quantity of heat disappears than when any other solid is changed into its corresponding liquid. Whenever by the application of heat a solid is converted into a liquid heat disappears. Ice, *e.g.*, melts at 0°C. But the temperature of a mass of ice to which heat is applied does not rise beyond 0° until all the ice is turned into water. Thus, the heat of the fire applied to the ice melts it, without raising its temperature. The heat that was perceptible by its action upon the thermometer no longer affects that instrument. The mass of ice at 0° has become a mass of water at 0°. The heat has been rendered *potential* or *latent*. As soon as all the ice has become water, the continued application of heat will cause the temperature of the water to rise.

In the melting of every solid, heat becomes potential or latent. It has the power to do work, but is not doing work. It is not, for the time being, kinetic heat. κινησις (kinēsis)=movement. In the case of ice, a larger quantity of kinetic heat is rendered potential than in the conversion of any other solid into its corresponding liquid.

To understand how much heat passes from the kinetic to the potential condition when ice becomes water, the meaning of the phrase *heat-unit* must be explained. A heat-unit, or thermal unit, or gram-degree, is the quantity of heat necessary to raise the temperature of a gram of water from 0° to 1°. Note that this unit quantity of heat is by no means the same as a degree of temperature. These two quite different things must not be confounded.

20	grams	of	water	raised	from	0°	to	1°	require	20 heat-units.
20	„		„	„		0°	„	10°	„	200 „ „
40	„		„	„		10°	„	100°	„	3600 „ „

To convert 1 gram of ice at 0° into 1 gram of water at 0°, 79·2, or, approximately, 80 heat-units are required. Hence 1 gram of ice at 0° mixed with 1 gram of water at 80°, or mixed with 2 grams of water at 40°, or mixed with 80 grams of water at 1°, or mixed with 10 grams of water at 8°, would result in 2, 3, 81, 11 grams of water, respectively, at 0°.

Some examples on the potential heat of water will be given after the consideration of water itself.

(β.) Water.—1. *Condition.*—A liquid freezing at 0°, boiling at 100°. The freezing-point and boiling-point of water are respectively 0° and 100°, only under normal conditions. With varying external circumstances they vary. The freezing-point is not always 0°. By cooling water, out of contact with air and kept perfectly still, a temperature of −10° or −15° has been reached before the water becomes ice. The slightest shaking of the water causes it suddenly to turn into ice, the temperature rising at the same time to 0°.

The freezing-point alters also with variation of pressure. When water turns into ice, expansions occurs. Thus 1 vol. of water at 0° becomes 1·09082 of ice. Anything that retards this expansion will make the conversion of water into ice more difficult. Increase of pressure will retard the expansion. Hence, if the pressure on the water is increased, solidification of the water is rendered more difficult, and a lower temperature (or in ordinary language, 'more cold') is required. The melting-point is lowered ·0075° for every additional pressure equivalent to that of a column of mercury 760 mm in height.

The boiling-point is not always 100°. It may be either higher or lower than 100°. The chief circumstances affecting the boiling-point are pressure, the nature of the vessel in which the water is placed, and the presence of salts in solution in the water.

i. *Pressure.*—Increase of pressure raises the boiling-point. Diminution of pressure lowers the boiling-point. When water becomes steam, as it passes off it has to overcome the pressure of the air upon the surface of the water. Any increase of that pressure makes it harder work for the water to become steam, and a higher temperature (or, in ordinary language, 'more heat') is required. 27 mm., measured in mercury, increase or diminution of the pressure on the water causes the boiling-point to rise or fall 1°.

ii. *The Nature of the Vessel.*—Water in a vessel made of some material to which the water adheres will boil at a higher temperature than in a vessel made of a material to which the water does not adhere. Adhesion between the water and the sides of the vessel tells against the passage of the water into the state of steam.

iii. *Presence of Salts in Solution in Water.*—As in the preceding case, adhesion of water to the particles that it holds in solution tells against the water passing off as steam. Distilled water boils, therefore, at a lower temperature than water containing matters in solution.

2. *Effect on Senses.*—Pure water is without taste or odour, colourless and transparent, unless seen in large quantity.

3. *Specific Gravity.*—Since water is taken as the standard of comparison for liquids and solids, its own specific gravity is 1. Water is about 11,937½ times as heavy as hydrogen, say, 11,940. It is 825 times as heavy as air.

4. *Solubility.*—

5. *Relation to Combustion.*—Not combustible.

6. *Specialties.*—It is 'the universal solvent.' The student should try the effect of distilled water on common salt, which is readily soluble, plaster of Paris (slightly soluble), chalk (insoluble). He should, after making a solution of common salt or of common 'soda,' (really, sodium carbonate), and of copper sulphate, evaporate each of the three solutions and observe the dissolved solids crystallise out as the solvent water passes off in the form of steam.

As a rule, the higher the temperature of the water, the more does it dissolve of the soluble substance, if the latter is a solid. In making a solution of a solid body, the force of cohesion between the particles of the solid has to be overcome. The adhesion between the water and the solid particles is in opposition to this cohesion and overcomes it when the solution is made. Heat, however, helps adhesion as it tends to separate the particles of the solid one from the other, and tells against the cohesion.

On the other hand, gases are less soluble in hot water than in cold. In gases the force of cohesion is *nil*. The particles of a gas are already repelling one the other.

Hence a rise of temperature in this case tells against the adhesion between the water and the gas.

From the experiments on page 260 and page 378 it will be seen that water is decomposed by sodium or potassium at the ordinary temperature, and by iron at a red heat. Other metals, such as copper and platinum, do not decompose water under any circumstances. Water combines with certain metallic compounds with great evolution of heat. Thus, if it is poured on quicklime (CaO), it unites with that compound to form calcium hydrate, and in the union much heat is evolved.

$$\underset{40+16}{CaO} + \underset{2+16}{H^2O} = \underset{40+2\,(1+16)}{Ca\,(HO)^2}$$
$$\underbrace{}_{56} \quad \underbrace{}_{18} \quad \underbrace{}_{74}$$

The effect of heat on water is peculiar. The majority of bodies when heated expand. If water at 0° has its temperature raised, instead of expanding it contracts until the temperature of 4·5° is reached. Then, if the temperature is still raised, the water behaves like liquids generally and expands regularly. Hence, if water at 4·5° is either cooled or heated it expands. This temperature is therefore called the point of maximum density of water. From this remarkable property of water it follows that when the surface of a mass of water, such as a lake, is cooling from the ordinary temperature of the air (say, 15°) downwards to 4·5°, that surface becoming cooler than the underlying regions of water is heavier than these, and constantly falls down. The lighter, hotter, originally underlying water, rising takes its place, and in its turn is cooled, becomes heavy, and falls. But when the temperature of 4·5° is reached, the upper layer of water begins to expand, is lighter than the water beneath it, and floats at the top. This it continues to do as the temperature falls from 4·5° to 0°, and then the surface water freezing, and again expanding as it freezes, the ice, a non-conductor of heat, is at the top of the lake and warmer water underneath.

The next special point to be considered in regard to water is of the same nature as that on which I dwelt for some time in considering ice. When water becomes steam a larger quantity of heat disappears than when any other liquid is changing into its corresponding gas. Whenever, by the application of heat, a liquid is converted into a gas, heat disappears. Water, *e.g.*, boils at 100°. But the temperature of a mass of water to which heat is applied does not rise beyond 100° until all the water is turned into steam. Heat is rendered potential or latent. As soon as all the water has become steam, the continued application of heat will cause the temperature of the steam to rise.

The number of heat units that are converted from the kinetic to the potential condition when 1 gram of water at 100° becomes 1 gram of steam at 100° is 536.

(To be continued.)

—o—

The New Class-Subject, 'Elementary Science.'

(What to teach, and how to teach it.)

BY RICHARD BALCHIN.

It is a great advantage to both teacher and scholar that the examination of the 'class-subjects' is generally oral and not written. With such young minds as we have to deal with, where the knowledge acquired is always far in advance of the ability to express it, it is an injustice to the teacher and a discouragement to the pupil to insist upon a written examination. Moreover, such a method of testing leads, in some cases, to mere cram, and to the learning by memory of certain answers to a few stereotyped questions; by which means, the whole purpose of science teaching is entirely frustrated. Indeed I have always felt sorry that the examination of even the specific subjects is by means of written answers only; in these cases, however, as the grant is given upon individual passes, I suppose an exclusively oral examination would be impracticable.

I would here impress upon the teacher the advisability of always performing the proposed experiment by himself before the class meets. I so often find that where this is not done the experiment is a complete failure, and the class is thrown into confusion.

The following simple notes form a continuation of the syllabus which appeared in the October issue of this magazine.

Lesson XVI.—The Chemistry of Water (*a*).

Water exists in nature in the three states—solid, liquid, and gaseous. In all three states, it has, of course, the same composition. It is an oxide—the protoxide of hydrogen, H_2O. When water is separated into its elements, these appear as the two gases, hydrogen and oxygen. Here refer to a previous lesson for the main characters of those gases; and contrast those characters with the properties possessed by the compound. There are two volumes of H to one of O; or sixteen parts by weight of oxygen to two of hydrogen. Water may be analysed by (*a*) heat, (*b*) by electricity, (*c*) by displacement.

First by heat. It was the opinion of Captain Shaw, of the London Fire Brigade, that when water was poured into an intensely hot part of a burning building the fire blazed up with greater fierceness. The water was, in fact, decomposed; giving rise to hydrogen, which at once inflamed, and to oxygen, which supported the combustion. Picture these effects before the boys. If possible, perform the following experiment. Get a piece of ½-inch iron pipe (gas pipe) two feet long. Weigh out exactly two ounces of very small iron brads, or, preferably, some clean iron turnings. Stuff them into the middle part of the pipe. This can be done by ramming them from both ends of the pipe with two pieces of iron rod. Fix into each end of the pipe, by means of perforated corks, a length of glass tubing. Fit the free end of one tube into the neck of a flask containing water to be boiled. Let the free end of the other tube dip under a collecting jar at the pneumatic trough. Light at least *two* Bunsen burners, and place them under the middle part of the iron tube, so as to make it, and the iron turnings within it, red hot. Boil the water in the flask, over a spirit lamp. The invisible water-vapour from the flask passes into the iron pipe and over the red-hot iron turnings: these absorb the oxygen from the H_2O, and form an oxide of iron—the black oxide, Fe_3O_4; while the remaining hydrogen passes out of the iron pipe and may be collected in the usual way and tested.

$$4H_2O + Fe_3 = Fe_3O_4 + 4H_2.$$

This experiment demonstrates the composition of water by analysis. If the iron turnings be now cleared out of the pipe and weighed, the boys will see what they have gained by their union with oxygen.

A supplementary lesson may be given to demonstrate the composition of water synthetically. Get some hydrogen, by displacing it by means of the

metal zinc from dilute sulphuric acid; and burn a jet of it in a cool bell-jar, to the interior of which introduce a supply of oxygen. A large quantity of water-vapour is formed, which condenses upon the inner surface of the jar.

LESSON XVII.—THE CHEMISTRY OF WATER (*b*).

Water may be decomposed into its elements by electric force. This method of analysis is termed the 'electrolysis' of water. The two elements thus obtained are the gases hydrogen and oxygen. It is the general opinion that this electrolysis of water is performed on a grand scale in nature. This has been alluded to in a former lesson. The electrical discharges in the atmosphere—*i.e.*, lightning—decompose some of the aqueous vapour always present in the air. The hydrogen of the water combines with the nitrogen of the air to form ammonia, NH_3, and the oxygen of the water is concentrated into a condensed form called ozone, O_2. (*Note.*—In my last article, ozone was, by a printer's error, given as NO_2; it should have been O_3.)

To analyse water by electric force, get two, at least, of Grove's cells. Invert two test tubes filled with water over a basin of the same, so that the tubes just dip into the liquid, which should be acidulated with a little sulphuric acid, as water is a non-conductor. To the ends of the wires from the battery join small platinum plates; pass these up a short distance into the test tubes, and then set the cells to work by pouring some dilute sulphuric acid around the zinc plate for the positive pole; and strong nitric acid around the platinum plate in the porous cells of the battery for the negative pole. Bubbles of gas now appear, covering the small plates in the test tubes. That at the positive pole is oxygen, that at the negative pole is hydrogen. These gases rise in the tubes and displace the water. The hydrogen is, in volume, double of the oxygen.

Note.—When performing this experiment with very small long test tubes, it is soon seen that the vols. of hydrogen and oxygen are in a greater ratio than 2 : 1; but this is in consequence of the greater solubility of oxygen in water than of hydrogen. (100 vols. of water at 15° C. absorb 1·93 vols. of hydrogen and 2·99 vols. of oxygen.)

This experiment demonstrates the composition of water by electrical analysis; but the same may be demonstrated by electrical synthesis. Thus: if the two gases, H and O, be mixed in the proportion of 2 to 1 in a strong glass tube and exploded by the electric spark, the *whole* of the gases disappear and water is formed. If the gases be mixed in a different proportion than 2 to 1, still it is only in this proportion they combine; the excess in either case is left behind.

LESSON XVIII.—THE CHEMISTRY OF WATER (*c*).

The composition of water may also be demonstrated by the absorption of its oxygen by means of some substance which has a powerful affinity for this element. The substances usually employed for this purpose are the metals sodium (Lat. natrium) and potassium.

Show the boys a piece of sodium. Looks like chalk. Cut it through with a penknife; note the metallic, leadlike lustre, and the coating of white powder. The powder is the oxide of sodium, Na_2O. Oxygen has a great affinity for sodium. Have ready a basin or an iron saucer of water; throw a piece of sodium, half the size of a pea, on the water. Note the following facts. It is lighter than water, and floats. (Sp. gr. of sodium, 0·97.) It becomes hot, and melts to a liquid globule of silvery brilliancy, which floats about with a hissing noise, accompanied sometimes with flame. This is a beautiful and most suggestive experiment. We have the separation of water into its elements, hydrogen and oxygen; the rapid union of the oxygen with the metal to form the oxide. This combination generates heat.

(If the intelligence of the class is above the average, draw a word-picture to the boys, of the fierce dashing and clashing together of the millions of atoms of oxygen (torn from the liquid) with the atoms of sodium; and of the motion—chemical force or affinity—being translated into the motion, heat.)

The heat thus generated melts the sodium. (Sodium fuses at 194° F.) The hissing noise is the escape of the hydrogen, liberated from the water. The molten metal getting intensely hot, a heat is generated sufficient to inflame the hydrogen. The incidental facts connected with this experiment are most instructive; such as the globular form assumed by the metal, the instant it becomes liquid; the rapid motion of the globule, due to the force of the escaping hydrogen, and probably to the conversion of some of the water to steam immediately under the globule.

The hydrogen may be collected by wrapping the fragment of sodium in a small piece of blotting-paper, and holding the same in a coil of wire down in water under an inverted test-tube also filled with water.

LESSON XIX.—COMPOUNDS OF OXYGEN.

Oxygen has so great an affinity, either directly or indirectly, with all the other elements, with the single exception of fluorine, that we may expect to find many important compounds of it. Recapitulate the fact and illustrations, that *burning* or combustion is really the act of combination of certain substances with oxygen. First we will take the compounds of oxygen with iron. Symbol for iron is Fe (Lat. ferrum).

Get a rusty nail, rub off the rust on to a boy's finger; this rust is an oxide of iron. Show the class a small bottle of water in which a few iron brads have been soaked; the water is coloured red, by oxide of iron. Show a piece of white sandstone, or bottle of white sand; and a piece of red sandstone, or bottle of red sand. Redness due to the presence of an oxide of iron. In the case of the red sandstone, some water containing iron (*e.g.*, a mineral spring) has soaked into a bed of sand and consolidated it into a red stone.

Refer to the experiment described in Lesson XVI., where iron at a red heat combines with the oxygen of water-vapour to form the black oxide of iron, Fe_3O_4. The red oxide of iron, often found as an iron-ore, and called 'hœmatite,' is Fe_2O_3. The simplest oxide is the protoxide FeO; but so great is the affinity of oxygen for iron, that unless this compound be kept from contact with oxygen it combines further with the latter and forms higher oxides.

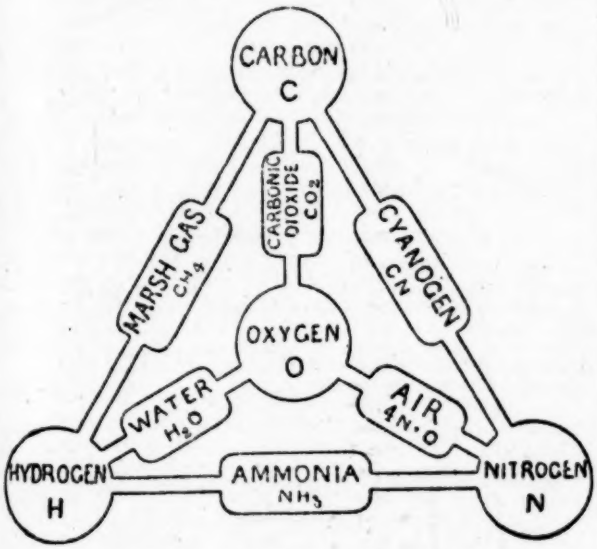
Cold iron does not combine with the oxygen of the atmosphere, but only with the moisture contained in the latter. If, however, an iron poker be frequently

placed in the fire and made red-hot, the iron gets coated with a layer of red oxide, which cakes off, and, as the boys will have observed, the poker gets smaller and smaller.

LESSONS XX. TO XXII.

The substance of these lessons on the further compounds of oxygen is given with sufficient fulness in the 'Science Reader' for Standard V. On page 140 of that book there is a diagram which the teacher will find extremely useful. I have enlarged it to six feet by four; and it is always up before the class during a lesson. In addition to what is on the diagram I have placed under each element and compound its symbol or formula. To question frequently upon the various combinations figured in this striking diagram is invaluable as a recapitulatory exercise.

Diagram showing the chief combinations of oxygen, etc.



(To be continued.)

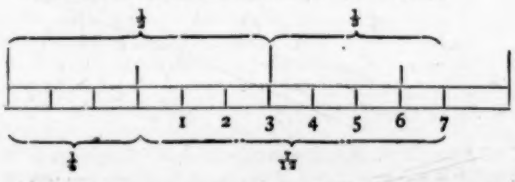
My Scholarship Answers.

BY H. D'ALBERTANSON.

First on the Scholarship List, 1884.

Arithmetic.

1. (*b*) Make a diagram showing that :—$\frac{1}{2}+\frac{1}{3}-\frac{1}{4}=\frac{7}{12}$.



(*c*) Show that not more than four aliquot parts are required for finding by practice the value of 3178 articles at £1 13s. 9½d. each.

10s.	½	3178 at £1 13s. 9½d.	
3s. 4d.	⅓	£1589	= cost of 3178 at 10s.
5d.	1/24	£529 13s. 4d.	= " " " " 3s. 4d.
½d.	1/240	£66 4s. 2d.	= " " " " 5d.
	of	£9 18s. 7½d.	= " " " " ½d.
	10s.	£5372 16s. 1½d.	= Cost of 3178 at £1 13s. 9½d.

(*c*) How would you prove the correctness of the ordinary method of converting the vulgar fraction $\frac{7}{16}$ into a decimal?

$$16)7\cdot0000$$
$$\cdot4375$$

Now $\cdot4375=\frac{4375}{10000}=\frac{4375\div625}{10000\div625}=\frac{7}{16}$. Q. E. D.

3. Find the number of yards of paper 2 ft. wide required for a room 35 ft. long, 25 ft. wide, and 10 ft. high, allowing for a door 7 ft. high and 6 ft. wide, two windows, each 6 ft. high and 4 ft. wide, and a fireplace covering 18 sq. ft.

Sq. ft.
$7\times6=42$ Area of door
$6\times4\times2=48$ " " windows
18 " " fireplace
∴ 108 sq. ft. = amount to be deducted.

ft. ft. sq. ft.
$35\times10\times2=700$
$25\times10\times2=500$
∴ 1200 sq. ft. = Total area of 4 sides of room.
108
2)1092 sq. ft. = Area to be papered.
3) 546 ft. = No. of ft. of paper.
182 yds. Ans.

4. The value of a Spaniard's work to that of a Frenchman's being as 3 : 4, and their daily rate of wages being 5s. and 7s. respectively; find the gain obtained by employing 100 Spaniards for 21 days instead of Frenchmen.

4 Sp. = 3 Fr.
∴ 1 Sp. = ¾ Fr.
∴ 100 Sp. = $\frac{3\times100}{4}$ Fr.

∴ $\frac{\overset{25}{\cancel{100}}\times\overset{1}{\cancel{5}}\times21}{\underset{1}{\cancel{4}}}=525$ = Cost of 100 Sp. for 21 days.

And $\frac{3\times\cancel{100}\times7\times21}{4\times\cancel{20}}=£551\ 5s.$ = Cost of Fr. for 21 days.
∴ £551 5s. − £525 = £26 5s. Ans.

5. If 4 ac. 2 ro. 39 ps. of land cost £768 9s. 9d. what would 9 ac. 2 ro. 13 ps. cost?

ac.	ro.	ps.		ac.	ro.	ps.		£	s.	d.
4	2	39	:	9	2	13	::	768	9	9
4				4						
18				38						
40				40						
759				1533						

511

∴ $\frac{£768\ 9s.\ 9d.\times\overset{511}{\cancel{1533}}}{\underset{253}{\cancel{759}}}=£3\ 0s.\ 9d.\times511=£1552\ 3s.\ 3d.$ Ans.

6. What fraction of 4s. 7d. will exceed ⅔ of 5⅝ of 2s. 1d. by 1s. 5d.?

$$(\tfrac{3}{7}\times\overset{4}{\cancel{27}}\times\overset{5}{\cancel{45}}\ \text{of 2s. 1d.})+1s.\ 5d.=\left(\frac{3}{\underset{1}{\cancel{7}}}\times\frac{\overset{4}{\cancel{27}}}{\underset{1}{\cancel{5}}}\times\frac{\overset{5}{\cancel{45}}}{1}\right)+17=$$

$60+17=77d.$ ∴ $\frac{77d.}{4s.\ 7d.}=\frac{77}{47}=1\frac{30}{47}$. Ans.

7. Add together 1·3 of 2s. 6d., 1·025 of 1s. 8d., 3·7 of 2s. 0¾d., 3·15 of 2s. 9½d., and reduce their sum to the decimal of £1.

			s.	d.
1·3	of 2s. 6d.	$=1\frac{3}{10}$ of 2s. 6d. = 2s. 6d. + 9	= 3	3
1·025	of 1s. 8d.	$=1\frac{1}{40}$ of 1s. 8d. = 1s. 8d. + ½d.	= 1	8½
3·7	of 2s. 0¾d.	$=3\frac{7}{10}$ of 2s. 0¾d. = 6s. 2¼d. + 1s. 7½d.	= 7	9¾
3·15	of 2s. 9½d.	$=3\frac{3}{20}$ of 2s. 9½d. = 8s. 5¼d. + 5¼d.	= 8	10½
			21	7½

s. d.
$\therefore \frac{21\ 7\frac{1}{2}}{20s.} = \frac{259\frac{1}{2}}{240} = \frac{519}{480} = 1{\cdot}08125$. Ans.

10. Find the breadth of a tank 70 ft. long and 3 ft. deep, which contains 36288 gallons (a gallon contains 277·274 cubic inches).

6
inc. ft.
$\frac{277{\cdot}274 \times 36288}{70 \times 3 \times 12} = \frac{1663{\cdot}644}{5 \times 12} = \frac{332{\cdot}7288}{12} = 27{\cdot}7274$ ft. Ans.
5

11. Find in inches to three places of decimals the side of a square which contains 41·9 square ft.

41·9
144
1676
1676
419
6033·6(77·676...inc. Ans.
49
147)1133
1029
1546)10400
9276
15527)118400
108689
155346)971100
932076

12. Find the annual rent of a house on which, after deducting 20 per cent., a rate of 3s. 1d. in the pound produces a sum of £38 17s.

s. d. £ s. £
3 1 : 38 17 :: 1 : x = Rent − 20 per cent.
12 20
37 777
12
37)9324(£252 = Rent − 20 per cent. or $\frac{1}{5}$
74
192 $\therefore \frac{4}{5}$ of Rent = 252
185 $\therefore \frac{1}{5}$ „ „ = 63
74 $\therefore \frac{5}{5}$ „ „ = $\frac{252 \times 5}{4} = £315$. Ans.
74
...

13. Find the length of a floor 18 ft. wide; the difference of cost if covered with asphalte 2 inches deep at 18s. per cubic yard or with gravel 6 in. deep at 7s. per cubic yard amounting to £6.

s.
If 36 in. deep the cost of 1 sq. yd. of asphalte = 18
$\therefore$ If 1 „ „ „ „ „ 1 sq. yd. „ „ = $\frac{18}{36}$
$\therefore$ If 2 „ „ „ „ „ 1 sq. yd. „ „ = $\frac{18 \times 2}{36} = 1s.$

s.
If 36 in. deep 1 sq. yd. of gravel costs 7
$\therefore$ If 1 „ „ 1 „ „ „ $\frac{7}{36}$
$\therefore$ If 6 „ „ 1 „ „ „ $\frac{7 \times 6}{36} = 1\frac{1}{6}s. = 1s.\ 2d.$

s. d. s. d. d.
$\therefore$ Diff. of cost for 1 sq. yd. = 1 2 − 1 0 = 2

$\therefore \frac{£6}{2} = \frac{240 \times 6}{2} = 720$ = No. of sq. yds. in floor

sq. yds.
$\therefore$ Length = $\frac{720}{18 \text{ ft.}} = \frac{720 \times 9}{18} = 360$ ft. Ans.

14. A wine merchant buys 500 galls. of brandy at 40s. per gall., and 600 at 50s. per gall. At what price should he sell them mixed together to make a gain of 10 per cent.?

£
500 at £2 = 1000
600 at £2½ = 1500
$\therefore$ Cost price of 1100 galls. is 2500
10 per cent. of 2500 = 250
$\therefore$ Selling price of 1100 galls. is 2750
$\therefore$ „ „ 1 gall. is $\frac{2750}{1100} = £2$ 10s. Ans.

15. A person invests in the 3 per cents. so as to obtain interest at the rate of £2 19s. 3$\frac{81}{89}$d. per cent. per annum. Find the price of stock.

£ s. d. £ £
2 19 3$\frac{81}{89}$: 3 :: 100
20 240
59 720
2 809
711 6480
809 57600
6399 576)58248(101½. Ans.
56880 576
801 648
576 576
72

Euclid.

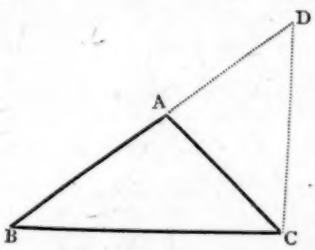
1. Any two sides of a triangle are greater than the third side.

If a straight line be drawn from the vertex of a triangle bisecting the base, the line together with half the base is greater than half the sum of the two sides.

Any two sides of triangle ABC are greater than the third.

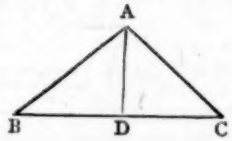
Produce BA to D, making AD = AC (I. 3).

Join DC.



$\because$ AD = AC, $\therefore$ angle ADC = angle ACD (I. 5).

But BCD is greater than ACD (Ax. 9). $\therefore$ BCD is greater than ADC. And $\because$ BCD is greater than BDC, $\therefore$ side BD is greater than side BC (I. 19). But BD is = BA and AC (Const.) $\therefore$ BA and AC are greater than BC. In same manner it may be proved that AC and BC are greater than BA, and CB and BA than AC. Wherefore any two sides, etc. Q. E. D.



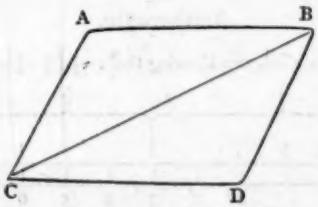
Let AD be drawn bisecting the base, then AD and BD or DC is greater than ½(AB and AC).

$\because$ AD and DB are greater than AB (I. 20), and AD and DC are greater than AC (I. 20), also DC = BD (Hyp.). $\therefore$ 2AD and 2BD are greater than AB and AC. Wherefore AD and BD are greater than half of AB and AC (Ax. 7). Q. E. D.

(2) Every parallelogram is bisected by its diameter.

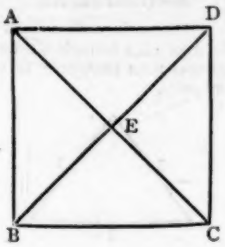
Under what conditions will the lines bisecting the opposite angles of a parallelogram be coincident?

The parallelogram ABCD is bisected by its diam. CB.



$\because$ AB = CD (I. 34, former part), and angle ABC = angle BCD, also CB is common to two triangles, ABC, BCD. $\therefore$ triangle ABC is = triangle BCD (I. 4). *Wherefore* ABDC is bisected by BC. Q. E. D.

In parallelogram ABCD let BE, ED, bisecting the angles ABC and ADC, be coincident, also the lines AE, EC bisecting BAD and BCE, and let the two diagonals thus formed cut at E.



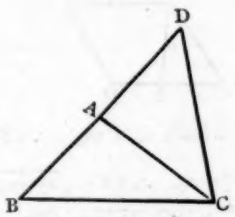
The figure ABCD is a square. ∵ angle ADB=DBC (I. 27), and DBC=ABD (Hyp.) ∴ ADB=ABD (Ax. 1). ∴ side AB=AD (I. 6), and the sides opposite to these are equal (I. 34). ∴ the figure ABCD is equilateral.

Again, ∵ ABD=ADE and BAE=DAE (Hyp.), also side AB=side AD. ∴ angle AEB=angle AED (I. 26). Wherefore each of them is a right angle (I. 14). And ∵ AEB is a right angle, ∴ ABE and BAE are together=a right angle (I. 32), but ABE has been proved=BAE (I. 26). ∴ ABE and BAE are each=half a right angle, and the wholes BAD and ABC are each=a right angle. Wherefore the fig. is rectangular, and it was proved equilateral. It is, therefore, a square (I. Def. 30).
Q. E. D.

(3) If the square described on one of the sides of a triangle be equal to the squares on the other two sides of it, the angle contained by these two sides is a right angle.

Write out the corresponding formula for the square on the side of an obtuse-angled triangle.

Let the square on BC be=sqs. on AB and AC, then BAC is a right angle.

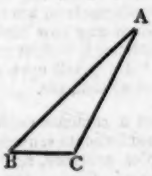


At A make CAD a rt. angle (I. 23), and make AD=AB (I. 3).

Join DC. ∵ sq. on DC=sqs. on AD and AC (I. 47), and AC=AD, ∴ sq. on DC=sqs. on AB and AC=sq. on BC (Hyp. and Ax. 1). ∴ DC=BC.

Again, ∵ DC=BC, AC is common, and AB=AD, ∴ triangle ABC is=triangle ADC (I. 8). ∴ angle BAC is=angle DAC, but DAC is a rt. angle. ∴ BAC is a right angle. Wherefore, if the sq. described, etc. Q. E. D.

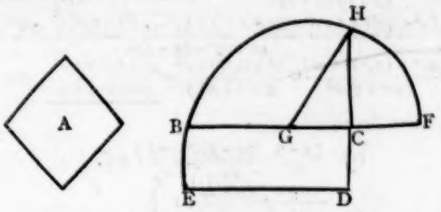
If the square described upon one side of a triangle be greater than the squares described upon the other two sides of it, the angle contained by these two sides is an obtuse angle.



Let sq. on AB be greater than sqs. on BC and AC, BCA is an obtuse angle, for it cannot be a rt. angle (I. 47), neither can it be an acute angle (II. 13). It must ∴ be an obtuse angle.

4. To describe a square that shall be equal to a given rectilineal figure.

To divide a given straight line into two parts so that the rect. contained by the two parts shall be equal to the sq. on one-fourth of the given line.



Describe the rectangle BEDC=given fig. A (I. 45).

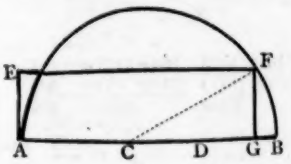
If BC=CD, the fig. is the required sq. But if not, produce BC to F, making CF=CD (I. 3). Bisect BF in G (I. 10), and from centre G with radius GB or GF describe semi-circle BHF. Produce DC to H. The sq. on CH is the required sq.

Join GH. ∵ The sq. on GF is=the rect. BC.CF, and the sq. on GC (II. 5) and GF is=GH (I., Def. 15). ∴ the sq. on GH is=the rect. BC.CF, and the sq. on GC (Ax. 1). But the sq. on GH is=the sqs. on GC and CH. Take away the common sq. on GC, and the remaining sq. on HC is=the remaining rectangle BC.CF, but CF=CD (Cons.) ∴ the sq. on HC is=rect. BD.

Again, BD is=A. ∴ sq. on HC is=A (Ax. 1). Q. E. D.

Bisect AB in C, and CB in D (I. 10). Then DB=one-fourth of AB.

Upon AB describe semi-circle AFB, and at A draw AE at rt. angles to AB and=BD (I. 11). Draw EF parallel to AB (I. 31), and FG parallel to EA.



The rect. AG.GB is equal to sq. on FG=sq. on DB=sq. on one-fourth of AB. Proof as above (II. 14) by joining FC, etc.
Q. E. D.

Algebra.

7. Write down the factors of $x^2+3x-10$, x^6-1, $9x^2+15x-14$. Add together $\frac{1}{a-b}+\frac{1}{b-c}+\frac{1}{c-a}$.

$$x^2+3x-10=(x+5)(x-2)$$
$$x^6-1=(x^3+1)(x^3-1)$$
$$=(x+1)(x^2-x+1)(x-1)(x^2+x+1)$$
$$=(x+1)(x-1)(x^2-x+1)(x^2+x+1)$$
$$9x^2+15x-14=(3x+7)(3x-2).$$

$$\frac{1}{a-b}+\frac{1}{b-c}+\frac{1}{c-a}$$
$$=\frac{(b-c)(c-a)+(a-b)(c-a)+(a-b)(b-c)}{(a-b)(b-c)(c-a)}$$
$$=\frac{bc-ab-c^2+ac+ac-a^2-bc+ab+ab-ac-b^2+bc}{(a-b)(b-c)(c-a)}$$
$$=\frac{ab+ac+bc-a^2-b^2-c^2}{(a-b)(b-c)(c-a)}. \quad \text{Ans.}$$

8. Divide $7x^2-\frac{1}{7}$ by $x+\frac{1}{7}$, and find the value of $\frac{x^2+y^2}{x^2-y^2}$ when $x=\frac{a+b}{a-b}$ and $y=\frac{a-b}{a+b}$.

$$x+\tfrac{1}{7}\;)\,7x^2-\tfrac{1}{7}\;(\,7x-1. \quad \text{Ans.}$$
$$7x^2+x$$
$$-x-\tfrac{1}{7}$$
$$-x-\tfrac{1}{7}$$
$$- \quad -$$

$$\frac{x^2+y^2}{x^2-y^2}=\frac{\left(\frac{a+b}{a-b}\right)^2+\left(\frac{a-b}{a+b}\right)^2}{\left(\frac{a+b}{a-b}\right)^2-\left(\frac{a-b}{a+b}\right)^2}$$

$$= \frac{\frac{(a+b)^4+(a-b)^4}{(a-b)^2(a+b)^2}}{\frac{(a+b)^4-(a-b)^4}{(a-b)^2(a+b)^2}} = \frac{(a+b)^4+(a-b)^4}{(a+b)^4-(a-b)^4}$$

$$= \frac{(a^4+4a^3b+6a^2b^2+4ab^3+b^4)+(a^4-4a^3b+6a^2b^2-4ab^3+b^4)}{(a+b)^4-(a-b)^4}$$

$$= \frac{2a^4+12a^2b^2+2b^4}{8a^3b+8ab^3} = \frac{a^4+6a^2b^2+b^4}{4(a^3b+ab^3)} = \underline{\frac{a^4+6a^2b^2+b^4}{4ab(a^2+b^2)}}.$$ Ans.

9. Solve the equations :—

$$(1)\quad \frac{5x-9}{8}+\frac{7x-1}{10}=\frac{11x+7}{15}+6.$$

$$(2)\quad \left.\begin{aligned}\frac{2x+2}{10}&=\frac{5y-11}{4}+1\\ \frac{3x}{2}+\frac{5y}{4}&=25\tfrac{1}{2}\end{aligned}\right\}$$

$$\frac{5x-9}{8}+\frac{7x-1}{10}=\frac{11x+7}{15}+6$$

Multiply by 120, then

$$75x-135+84x-12=88x+56+720$$
$$\therefore\ 75x+84x-88x=56+720+12+135$$
$$\therefore\ 71x=923$$
$$\therefore\ x=\underline{13}.\quad \text{Ans.}$$

$$(2)\quad \frac{3x+2}{10}=\frac{5y-11}{4}+1 \quad \text{(I.)}$$
$$\frac{3x}{2}+\frac{5y}{4}=25\tfrac{1}{2} \quad \text{(II.)}$$

Multiply both equations by 20.

From (I.) $6x+4=25y-55+20$
$\therefore\ 6x-25y=-39$ (III.)
From (II.) $30x+25y=505$ (IV.)
By addition $36x = 466$
$\therefore\ x = \frac{466}{36} = 12\frac{34}{36}.$
$= \underline{12\tfrac{17}{18}}.$

Multiply (III.) by 5, then $30x-125y=-195$
Subtract (IV.) $30x+25y=505$
Then $150y=700$
$\therefore\ y=\frac{700}{150}.$
$= \underline{4\tfrac{2}{3}}.$ Ans.

10. In the quadratic equation $x^2+ax+b=0$, show that $-a$ = the sum of the roots.

Solve the equation $2x+\sqrt{x^2+7x+23}-25=0$.

$x^2+ax+b=0 \quad \therefore\ x^2+ax=-b$

$$\therefore\ x^2+ax+\left(\frac{a}{2}\right)^2=\frac{a^2}{4}-b$$

$$\therefore\ x+\frac{a}{2}=\pm\frac{\sqrt{a^2-4b}}{2} \quad \therefore\ x=\frac{\sqrt{a^2-4b}-a}{2}$$

$$\text{or}\ \frac{-\sqrt{a^2-4b}-a}{2}$$

$$\therefore\ \frac{\sqrt{a^2-4b}-a}{2}+\frac{-\sqrt{a^2-4b}-a}{2}=\frac{-2a}{2}$$
$$=\underline{-a}.\quad \text{Q. E. D.}$$

$$2x+\sqrt{x^2+7x+23}-25=0$$
$$\therefore\ \sqrt{x^2+7x+23}=25-2x.$$

By squaring, $x^2+7x+23=625-100x+4x^2$

$$\therefore\ 3x^2-107x=-602$$
$$\therefore\ x^2-1\tfrac{2}{3}\tfrac{7}{3}x+(1\tfrac{2}{3}\tfrac{7}{3})^2=2\tfrac{1}{3}\tfrac{4}{6}\tfrac{2}{9}-0\tfrac{2}{3}\tfrac{2}{9}$$
$$=\frac{11449-7224}{36}=4\tfrac{2}{3}\tfrac{2}{6}$$
$$\therefore\ x-1\tfrac{2}{3}\tfrac{7}{3}=\pm\tfrac{2}{6}\tfrac{1}{9} \quad \therefore\ x=1\tfrac{2}{3}\tfrac{7}{3}\pm\tfrac{2}{6}\tfrac{1}{9}=\underline{28\tfrac{2}{3}\ \text{or}\ 7}.\quad \text{Ans.}$$

11. An avenue is planted with trees 20 ft. apart; if the trees had been planted 15 ft. apart the cost would have been increased by £5 at 2s. for each tree; find the length of the avenue.

Let x = Length of the avenue.

Then $\frac{x}{20}+1$ = No. of trees in first case.

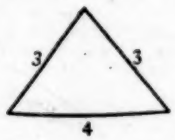
And $\frac{x}{15}+1$ = No. of trees in second case.

$$\therefore\ 2\left(\frac{x}{20}+1\right)+100=2\left(\frac{x}{15}+1\right)$$
$$\frac{x}{10}+2+100=\frac{2x}{15}+2$$

Multiply by 30, $3x+60+3000=4x+60$
$\therefore\ x=\underline{3000}$ ft. Ans.

Mensuration.

12. Show that the area of a triangle whose sides are in the ratio 3 : 3 : 4 is greater than $\frac{1}{3}$ the area of a square described on one of the shorter sides.



$3\times3=9$ = Area of sq. $\therefore$ $\frac{1}{3}$ of $9=4=\frac{4}{9}$ of area of sq.

$$\frac{3+3+4}{2}=5$$

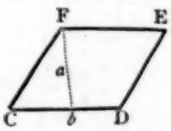
$\therefore\ 5\times2\times2=20$ = Sq. of the area of triangle.

$$84\overline{)400}\ \begin{matrix}20\\16\end{matrix}\ (4\cdot4\ldots = \text{Area of triangle.}$$
$$\underline{336}$$

Area of triangle $=4\cdot4\ldots$
$\frac{4}{9}$ Area of sq. $=4$
$\therefore$ Area of triangle is greater by $\underline{\cdot4\ldots}$ Q. E. D.

13. Find the length of the side of a parallelogram, one angle being half a right angle, the altitude being equal to half the base and the area containing 1250 sq. ft.

$a=\frac{1}{2}b \quad \therefore\ \frac{1}{2}b\times b=1250 \quad \therefore\ \frac{1}{2}b^2=1250$
$\therefore\ b^2=2500 \quad \therefore\ b=\underline{50}$ = the base.



Because angle at C is half a right angle, $\therefore$ CFB is = half a right angle (I. 32).

$\therefore\ Cb=a=\frac{1}{2}b=25. \quad \therefore\ CF=\sqrt{25^2+25^2}$
$=\sqrt{1250}=\underline{35\cdot35\ldots}$ Ans.

School Management.

1. Write full notes of a lesson on a complex sentence.

Introduction.—Write upon blackboard a simple sentence, as 'Honest men are happy,' and analyse. Show that the attribute, 'honest' may sometimes be a sentence itself, and convert the given sentence into 'Men *who are honest* are happy.'

Meaning of a subordinate sentence. Point out that the sentence 'who are honest' cannot be used by itself; it belongs to the noun, men, and thus depends upon the sentence, 'Men are happy.' Explain that such sentences are called '*subordinate*,' while sentences like 'Men are happy,' which can be used by themselves, are called *principal*.

Children may now note down: A subordinate sentence is a sentence which cannot stand alone, but depends upon some other sentence. A principal sen., etc.

The complex sentence. When a sentence contains both a principal and a subordinate sentence, the whole is called a complex sentence, as 'Men who are honest are happy.' Give a few other examples, children pointing out the principal and subordinate sentences.

Kinds of sub. sentences. If time permits, the three kinds of subordinate sentences may be noticed.

(*a*) The adj. sen. — In the sentence given above show that because 'who are honest' takes the place of an adjective it is called 'an adjective sentence.' Other examples.

(*b*) The noun sen. — Take another sentence, as 'The saying is true.' Change it into 'What they say is true,' and explain that 'What they say' is called a noun sentence, because it takes the place of a noun, viz., 'the saying.'

(*c*) The adverbial sen. — Take another sentence, as 'He came directly,' For 'directly' substitute 'when he was called,' and explain why it is an adverbial sentence. A few other examples will complete a full lesson.

2. Write out some of the chief principles to be observed in the lighting and ventilating of a schoolroom.

Lighting.—If possible, there should be two large windows at each end of the room, independently of side windows. The classes should be arranged so that the children do not sit in their own light. When gas is lit, the same care must be taken, the best place for the gas being generally down the centre of the room. The walls should not be painted white to reflect too much light.

Ventilation.—The windows should reach as near the ceiling as possible. There should be ventilators in the floor or near the ground. Care should be taken to avoid a draught, though a constant supply of fresh air is needed. No overcrowding should exist, and during the dinner-time the room should be thoroughly ventilated by opening doors and windows.

3. Point out some of the principal uses of a blackboard for teaching arithmetic, geography, and object lessons.

Arithmetic.—Working examples; setting down rules, and showing their reasons; to enable children to put down their sums neatly.

Geography.—For drawing sketch maps and diagrams; for summaries.

Object Lessons.—For illustrating by diagrams; for setting down chief facts taught; for recapitulation.

6. State how you would explain to a scholar in the third standard the value of the full remainder obtained in the division of 349 by 42 when the division is performed by the factors 6 and 7 *successively*.

We first divide by 6 to find how many sixes in 349, and we find that there are 58 sixes and a unit over.

We then divide by 7 to find how many sevens of these sixes there are, and we find that there are 8 sevens and two of these sixes over. Now the whole remainder is the two sixes and a unit, which is equal to 12+1, or 13, as shown in the example.

```
6)349
7) 58-1
   8 + 2 sixes + 1 =
   8 and 12 + 1 =
   8 and 13 over.
```

4. Name some of the subjects appropriate for home lessons, and give a sketch of a week's home lessons for scholars in the fourth standard.

Subjects appropriate for Home Lessons.—Examples in arithmetic; questions in geography or history; a short sentence to parse; spelling, with meanings to be written; maps, etc.

In giving home lessons I think it is a good plan to give one ex. in arithmetic every evening, together with a short exercise in some other subject.

A Week's Home Lessons.

Monday.	*Tuesday.*	*Wednesday.*	*Thursday*	*Friday.*
Arithmetic	Arithmetic	Arithmetic	Arithmetic	Arithmetic
Short sentence to parse.	Question in geog. or hist.	Words, with meanings.	Question in some lesson given during day.	Map

13. Distinguish the teaching of the rule of three by the method of unity and by proportion.

Take an example thus: If 4 men earn £20 in a certain time, how much would 10 men earn at the same rate?

Method of Unity.—We first write down the fact stated in the question, keeping the amount at the end of the line in the same name as the answer will be, thus:

4 men earn £20

We next take *one* of the other quantity, viz., men, and find what this one will earn, thus:

1 man earns £$\frac{20}{4}$

We now take the required number, thus:

10 earn £$\frac{20 \times 10}{4} = 50$

In Proportion we find in what name the answer is to be, and then place the quantity of that name given us in the question, viz., £20, in what is called the third term of the proportion.

We now take the other two quantities, and compare their values, thus: as many times as 10 is greater than 4 will our answer be greater than 20, and put the three terms down, thus:

4 : 10 :: 20 : Ans

which means 4 is to 10 as 20 is to the answer. The answer is obtained by multiplying the 2nd and 3rd terms together and dividing by the 1st, thus:

£$\frac{10 \times 20}{4} = 50$.

15. Give a brief sketch of a first lesson on the Adverb.

Introduction.—Write upon blackboard a short sentence as 'We walked.' Ask children to give words telling about 'walked.' Elicit such words as—quickly, slowly, onward, backward, yesterday, etc.

Definition of an adverb. — Now these words are added to the word walked. What part of speech is walked? Therefore these words are added to a verb, and are therefore called ad-verbs.

What does 'quickly' tell? (how); 'onward?' (where); yesterday? (when). Thus an adverb is a word that tells us how, when, and where actions are done.

Kinds of adverbs (three most common only). — What do we call the way in which a thing is done? (manner). Give few examples of adverbs of manner. Where it is done (place). Give examples. When it is done (time). Give examples. Take other similar sentences, and let boys arrange the adverbs in three columns, viz.: of time, place, and manner.

16. Write the words 'Geographical Analysis' in text hand, and give rules for the length of the letters *p*, *h*, *l*, and *y*.

Geographical Analysis.

Letter *p*. Above the line to about half the height by which the capital letter exceeds the other letters, and below the line to the whole of this distance.
" *h*. Above the line to the same height as the capital.
" *l*. The same as *h*.
" *y*. Below the line to a distance about equal to that by which *l* or the capital exceeds the other letters in height.

Geography and History.

1. Draw an outline map, with meridians and parallels, if you can, noting thereon the principal physical features of Italy.

2. Explain the following terms:—Meridian of Greenwich, Equatorial diameter, ecliptic, solstice, estuary, confluence, plateau.

Meridian of Greenwich.—The imaginary line drawn from Pole to Pole perpendicular to the Equator and passing through Greenwich. It is our first meridian of longitude, from which all others are reckoned E. or W.

Equatorial Diameter.—The diameter of the earth whose extremities are terminated by the Equator.

Ecliptic.—The path followed by the sun in its apparent annual motion. It is so called because eclipses take place when the moon is in this line.

Solstice.—The standing still of the sun caused by the sun reaching its northern or southern limit, viz.: the tropic of Cancer or Capricorn, when it turns again towards the Equator.

Estuary.—The opening worn by a river at its mouth.

Confluence.—A junction of two or more rivers.

Plateau.—An elevated plain or table-land.

3. Describe briefly in words the courses of the Ganges and the Nile.

The Ganges rises in the Himalayas, and flows south-east through the North-west Provinces and Bengal into the Bay of Bengal, which it enters by numerous mouths, the chief of which is called Hoogly. The swampy and low-lying district drained by the many mouths is called the Sunderbunds. It receives on the left the Gogra and Goomtee, and on the right the Jumna with the Chumbul. It passes the towns of Cawnpore, Allahabad, Benares, Patna, Moorshedabad, Dacca, Calcutta, Canning Town, and Chandernagore: on the Goomtee is Lucknow, and on the Jumna, Delhi and Agra.

The Nile is believed to rise in L. Tanganyika, from which it flows into the Victoria Nyanza; from this lake Sir Samuel Baker has traced it to L. Albert Nyanza, from which it issues and maintains a northward but winding course through Nubia and Egypt, falling to the level of the Mediterranean by a succession of cataracts and entering that sea by several mouths, after having traversed a distance of about 3,500 miles. It receives, on the right the Blue Nile and the Atbara with the Tacazze rom Abyssinia, while for the last 1,500 miles it receives no tributaries. The chief towns on its banks are Gondokoro, Khartoum, Shendy, Berber, Old and New Dongola, Derr, Assouan, Siout, Cairo, Rosetta, Damietta: on the Blue Nile is Senaar, and on the Atbara Gondar.

6. Give some account of the Soudan, Manitoba, and Ceylon.

The Soudan is a vast territory consisting of many independent states, stretching across Africa from Senegambia to Nubia. It is peopled chiefly by negroes, hence its name Nigritia, but in the east are many Arabs. Several of the states are flourishing, the chief occupations of the people being caravan trading, agriculture, and cattle-rearing, with a few rude manufactures and working in metals. Its chief towns are Soccatoo, the largest, and capital of Howsa; Timbuctoo, great caravan trade; Sego on Niger, and Boussa on same river, where Sir Mungo Park was drowned. The eastern part is, and has been for some time, in a state of great commotion and warfare, on account of the rise of the Mahdi or false Mahometan prophet.

Manitoba, or Red River Settlement, is situated about half way between Canada and the Rocky Mountains. It is inhabited by colonists and Indians, the former of whom are engaged in clearing the ground, the timber trade, and agriculture, whilst the latter live chiefly by hunting. The soil is rich and fertile, being either covered with forest trees or prairie land. The capital is Fort Garry.

Ceylon is the pear-shaped island lying off the south of India. The soil is fertile, and the island is very famous for the quantity and quality ot its spices, especially cinnamon. In the centre is a mountain, called Adam's Peak, and stretching across the Palk's Straits is a line of sandbanks, termed Adam's Bridge. Its chief towns are Kandy, the former capital; Colombo, the present capital; Point de Galle, a seaport, at which steamers touch on the way to Australia; and Trincomalee, a seaport on the east of the island.

7. Enumerate the chief productions of British North America, Queensland, and Jamaica.

British North America.—Timber (chiefly pine), wheat and other cereals, flax, hemp, tobacco; gold, coal, iron, and petroleum, or mineral oil; cattle, furs; fish (chiefly cod), sealskin, and produce of whale fishery.

Queensland.—Wool, cocoanut, and other palms in the tropical part, wheat and other cereals; sugar and cotton, but not to a very great extent; gold, coal, and iron.

Jamaica.—Sugar, rum, cotton, coffee, cocoa, spices, ginger, tobacco, mahogany, logwood, cocoanut, manioc, bread-fruit, etc.

History.

8. Arrange in chronological order, and give the dates of the following events:—The discovery of America; the battles of the Nile, Flodden, Bannockburn, and Marston Moor; the accession of Stephen, Anne, and Elizabeth; the Act of Habeas Corpus and of Slave Emancipation; the death of Becket, of Charles I., and Simon de Monfort.

Accession of Stephen, 1135; death of Becket, 1170; death of Simon de Monfort, 1265; battle of Bannockburn, 1314; discovery of America, 1492; battle of Flodden Field, 1513; accession of Elizabeth, 1558: battle of Marston Moor, 1644; death of Charles I., 1649; Habeas Corpus Act, 1679; accession of Anne, 1702; battle of Nile, 1798; Slave Emancipation Bill, 1833.

10. Explain the terms—Alderman, Magna Charta, feudal system, and viceroy.

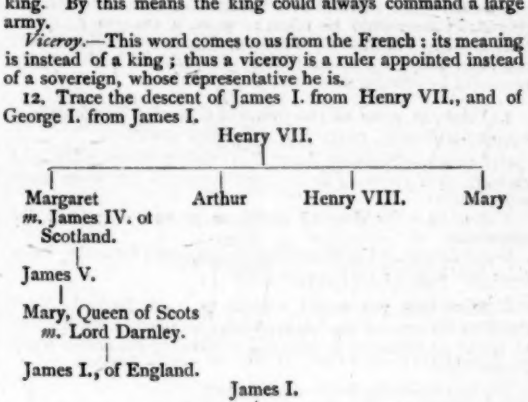
Alderman or Earl was originally the title of the old Saxon nobility; they formed the highest class of freemen, and ranked next to the king, after whom they were the principal members of the Witenagemote. They generally held a portion of land termed a shire, which it was their duty to govern. In the Norman times the terms alderman and shire were superseded by count and county.

The Magna Charta, or Great Charter of 1215, is generally regarded as the foundation of English liberty. Owing to the arbitrary and intolerable conduct of John, the barons of England drew up this code of laws, and calling a great meeting presented it to their sovereign at Runnymede, where the worthless monarch was compelled to sign it. Its chief provisions were:—1. That no freeman should be imprisoned, outlawed, etc., but by the judgment of his peers and by the law of the land. 2. That justice should be delayed or denied to no man. 3. That no taxes should be levied but by the consent of the Great Council, excepting on these occasions, viz., the knighting of king's eldest son, the marrying of his eldest daughter, and the ransom of the king's person. There were many other minor provisions granting further liberties to all classes of men.

The feudal system was that system of government in which the king let out the land to the barons, while the barons again let out their portions to their vassals. Instead of paying a rent, however, these vassals were obliged to furnish food for their lord's table, and to do him military service whenever required, the baron himself being bound to do the same service to the king. By this means the king could always command a large army.

Viceroy.—This word comes to us from the French: its meaning is instead of a king; thus a viceroy is a ruler appointed instead of a sovereign, whose representative he is.

12. Trace the descent of James I. from Henry VII., and of George I. from James I.



15. Name, with dates, the chief events of the latter half of the eighteenth century.

1752. Alteration of the Calendar.
1756. Seven Years' War commenced. French took Minorca.
1757. Pitt's first ministry. Battle of Plassey.
1759. Quebec taken: death of Wolfe.
1760. Conquest of Canada. Death of George II. Accession of George III.
1763. Grenville's ministry. Prosecution of Wilkes.
1765. American Stamp Act.
1771. Debates of the House first published.
1775. American War, Bunkers' Hill.
1776. American declaration of Independence.
1777. Battle of Brandywine.
1778. Surrender of Burgoyne at Saratoga.
1779. Siege of Gibraltar.
1781. Surrender of Lord Cornwallis at York Town.
1783. Treaty of Versailles.
1793. War with French Republic.
1794. Lord Howe defeated French fleet off Cape Ushant.
1795. Capture of Ceylon and Cape Colony.
1797. Jervis and Nelson defeated Spanish fleet off Cape St. Vincent.
1797. Dutch fleet defeated by Duncan off Camperdown.
1798. Battle of the Nile.
1798. Irish Rebellion. Vinegar Hill.
1799. Wellesley at Seringapatam.
1801. French defeated by Abercrombie at Alexandria.

(To be continued.)

Physiology.

BY ARTHUR NEWSHOLME, M.D. LOND.,

Gold Medallist and University Scholar, Physician to the City Dispensary.

CHAPTER XI.—THE CIRCULATION OF THE BLOOD—(*continued*).

Circulation in the Arteries.—Next to the heart, the arteries are the most important agents in the circulation of blood. At each contraction of the ventricles blood is forced into the already full arteries. Their elastic coats allow a local distension near the heart, to make room for the additional blood, and thus, at the same time, break the shock produced by the sudden propulsion of the blood. As soon as the semilunar valves close, the second great function of the arteries comes into play. The elastic tissues recoil, and drive on the blood to the peripheral parts of the arterial system. Thus the flow of blood is maintained during the time that the ventricles are at rest or becoming dilated. If it were not for this elasticity of the arteries, the propulsion of blood by the heart would be much more difficult, and rupture of the rigid tubes would be a frequent event.

The blood flows in intermittent jets from a severed artery, and the amount of *arterial pressure* causing this flow can be estimated in animals by connecting a hole in an artery with a U-shaped tube containing mercury. The average pressure is greatest in the largest arteries, and gradually diminishes as the arteries diminish in size. In the carotid artery of man (in the neck) it is probably equal to six to eight inches of mercury.

The *velocity of the flow* of blood in the arteries is, like the blood pressure, greatest in the largest arteries. It diminishes with the multiplication of small branch arteries, and, consequently, the subdivision of the current. This is comparable to the difference between the rapid flow of the water in a river whose bed is deep and narrow, and the sluggish flow in a shallow and wide bed. The area of the vascular system is greatest at the capillaries; the whole vascular system being represented by two cones, whose apices are at the heart, and whose bases join in the peripheral circulation. In the horse, Volkman found the velocity of the stream in the main artery of the neck (carotid) to be about twelve inches per second, and in an artery of the foot a little over two inches.

Inasmuch as the blood is not able to leave the arteries as quickly as it is forced into them by the ventricles, on account of the resistance in the capillaries, the already-mentioned arterial distension occurs. This is most marked in the largest arteries, but occurs throughout the arterial system. Each artery at the moment of distension becomes both longer and wider. This visible enlargement may in thin persons be seen at the wrist, and can always be felt by the finger. It is called the *pulse*. The same jetting force of the heart which causes the intermittent spurting of blood from a wounded artery causes the pulse. It is absent, in the normal condition, from capillaries and veins.

The exact character of the pulse can be studied by means of the sphygmograph. This is an instrument in which a small button is lightly placed over the pulse instead of the finger, as in the ordinary method of feeling the pulse. The up-and-down movement of the button is communicated to a delicate lever, which consequently vibrates, and is made to register its movements on smoked paper, which is moved by clockwork. The tracing thus obtained is found to present four distinct undulations. The first, or percussion wave is said to be due to the shock of the heart's systole, transmitted along the arteries, or possibly to the inertia of the long lever carrying it up a little too high. The secondary, or tidal wave is the true arterial wave. The third, or dicrotic wave has been variously explained. According to some, it is due to the shock of the closure of the aortic valves; but more probably to the elastic recoil of the arteries producing increased arterial tension. The fourth wave has probably the same relation to the third as the second to the first.

A careful distinction must be made between the passage of the *wave* along the arteries, and the velocity of the blood stream, the velocity of the former being twenty or thirty times that of the latter.

The muscular coat of the arteries has been already mentioned. This serves to confer muscular contractility on the arteries, by means of which active changes in their calibre can be effected. If the web of a frog's foot be watched under the microscope, the small arteries can be seen to become sometimes narrowed and sometimes dilated. The contact of cold with the web greatly diminishes the size of its arteries. In case of accidental rupture of an artery, muscular contractility greatly helps elastic resiliency in narrowing and closing the orifice of the vessel, and thus stopping the hæmorrhage.

The chief function of the muscular coat of arteries is to regulate the amount of blood to be received by each part. Nerve fibres belonging to the sympathetic system are distributed to the muscular fibres, and by their means the nervous system comes into close relationship with the vascular system. If the sympathetic nerve of the neck of a rabbit be divided, the minute arteries on the same side of the head become dilated, and the corresponding ear is much redder than its fellow. If the end of the cut nerve connected with the head be stimulated by an interrupted current, the arteries diminish in size, and the flushing ceases. Division of the sciatic nerve in a mammal causes a similar distension of the arteries of the leg. We may infer, therefore, that there are certain nerves, sometimes belonging to the sympathetic system, and sometimes to the cerebro-spinal system, stimulation of which causes a diminished supply, and paralysis an increased supply of blood to corresponding areas. These nerves are called *vaso-motor nerves.*

Circulation in the Capillaries.—In the capillaries, unlike in the arteries, the blood flows with a constant, though slow, motion. Owing to the great multiplication of surface, the friction is greatly increased, while the velocity of the current is at a minimum, owing to the widening of the stream. As the length of capillary to be passed through probably does not exceed in any part $\frac{1}{30}$th of an inch, the time expended is under one second; and in the capillaries of the lungs, probably considerably less than this. If the capillary circulation is watched in a frog, there will usually be seen a central current of red corpuscles, while white corpuscles progress less rapidly, and tend to hang about the capillary wall. Occasionally the white

corpuscles can be seen extruding themselves through the capillary wall, and migrating into the surrounding tissues. This is not owing to the presence of orifices in the capillary wall. The capillary wall must be regarded as a mass of living protoplasm, which closes again immediately a leucocyte has forced its way through.

There is, doubtless, a constant interchange between the blood in the capillaries and the surrounding tissues, and this interchange seems to facilitate the onward movement of the blood. In the lungs it is found that when the entrance of oxygen is prevented, the circulation through the lung capillaries is gradually retarded, until complete stagnation occurs.

Circulation in the Veins.—The chief obstruction to the circulation occurs in the capillaries; when this is overcome, the remaining force of the heart suffices to propel the blood, with a uniform current, through the veins. It might be imagined that gravity would retard the flow of blood to the heart from the abdomen and limbs. This is, however, not the case; for, by a law of hydrostatics, the pressure exerted by a column of blood in the arteries will always suffice to support a column of equal height in the veins. Of course, the lowest blood-vessels have the greatest pressure to bear, owing to the height of the column of blood; this partly accounts for the frequency of varicose veins of the leg.

In addition to the force exerted from behind by the heart, the venous circulation is greatly helped by muscular exercise. This presses on the veins in the neighbourhood, and as the valves prevent reflux, an onward impetus is the result. Owing to the free anastomoses of veins, this effect of muscular contraction presents no drawbacks.

(*To be continued.*)

—o—

Recent Inspection Questions.

[*The Editor respectfully solicits contributions—all of which will be regarded as* STRICTLY PRIVATE—*to this column. For obvious reasons, it cannot be stated in which district the questions have been set.*]

STANDARD I.

WRITING.—Chair, Leaves, Clock, Soap, Rabbit, Ground, Friday, Street, Paper, Night.

ARITHMETIC:—

(A.)		(B.)	
705		19	
86		850	
370		67	
49		472	
624		803	
1834	Ans.	2211	Ans.

915	810	603	856
370	46	410	379
545	764	193	477

TABLES were taken orally.

GEOGRAPHY.—Questions on plan. Scholar to show where he was sitting—walk to the north, walk from the south, etc.

MENTAL ARITHMETIC.—5+4+6. 20d. in pocket, I spend 5d., then 4d.; how much left? etc.

STANDARD II.

WRITING.—Dictation from 'Royal Reader,' First Series, page 20. 'At last . . . . any more.'

ARITHMETIC (DICTATED).

(A.)

3,678 × 806. Ans. 2,964,468.
Take 4,929 from 54,038. Ans. 49,109.
Divide 63,405 by 8. Ans. 7,925+5.

(B.)

4,826 × 806. Ans. 3,889,756.
Take 9,237 from 74,019. Ans. 64,782.
Divide 87,504 by 8. Ans. 10,938.

GRAMMAR.—Books open in front of scholars, who had to point out nouns and verbs orally.

GEOGRAPHY.—Meaning of 'axis,' comparison of 'axis' with 'axle'; cape, valley, river, local illustrations asked for. Shape of earth and its shadow.

MENTAL ARITHMETIC.—40+50+80−15. Call the answer pence. How many 3d. in 7s. 6d.? How many 1d. slate pencils for half-a-crown and sixpence? etc.

STANDARD III.

WRITING.—Nelson's 'Stories from English History,' page 81. 'Sir Philip . . . . and thoughtful.'

GRAMMAR.—Write down nouns, verbs, adjectives, and pronouns, from a page in reading book.

REPETITION.—Desk by desk—singly—altogether.

MENTAL ARITHMETIC.—How many 4d. in 8s. 4d.? Spent 6d. and 2d.; how much left out of 10d.? etc., and easy reductions of money.

GEOGRAPHY.—To point out on blank map, rivers, naval ports, 'cotton' towns, etc., of England.

ARITHMETIC—(ON CARDS).

Addition of money (6 lines), some in words and some figures.

2,094,741 ÷ 3098; ÷342.
Ans. (1) 676+493. (2) 6124+333.
751,284 ÷ 99. Ans. 7,588+72.
Find difference between £145 10s 7¼d. and £239 2s. 5d. Ans. £93 11s. 9¾d.
Two girls and a boy saved £10. The girls saved £2 4s. 9½d. each. How much did the boy save?
Ans. £5 10s. 5d.
A man bought 12 chickens for 4s. 9d. He gave for food 3s 6d, and sold each chicken for 1s. 9d. What profit did he make? Ans. 12s. 9d.

STANDARD IV.

DICTATION.—Nelson's 'Royal History Reader,' No. 1, p. 68; 'At that very moment . . . . Dunstan.'

ARITHMETIC.—(1) A wheel is 16 feet in circumference. How many times would it turn in 6 miles?
Ans. 1980.

(2) If sugar is 2½d. per lb., how many lbs. can be bought for £6 8s. 4d? Ans. 616.

(3) £2409 18s. 5½d. ÷ 96; ÷ 86.
Ans. (1) £25 2s. 0¾d. + 21. (2) £28 0s. 5½d. + 39.
(4) £15 7s. 4¾d. × 809. Ans. £12,434 3s. 2¾d.
(5) Bring 1,000 half-guineas to fourpences.
Ans. 31,500.
(6) How many farthings in 20½ guineas?
Ans. 20,664.
(7) 20,060 minutes to days.
Ans. 13 days, 22 hours, 20 mins.
(8) 8 miles 2 furs. 1 yd. 2 feet, to ins.
Ans. 522,780.
(9) 1,210,000 sq. yards to acres.
Ans. 250 acres.

} all set in words.

GRAMMAR.—Parse:

'Skylarks are plentiful everywhere.'
'Many there offered to buy it.'
'We shall call wild plants weeds.'
'No! I will never do that.'

STANDARD V.

Half the class were set dictation, the other half composition.

DICTATION.—Nelson's 'Pictures from English History,' page 230. 'Young Peel . . . . mathematics.'

COMPOSITION.—'An officer in the army of Frederick the Great, owed the king a sum of money. He wrote a list of his debts, and underneath it put: "Who will pay these debts for me?" He thereupon went to sleep, and the king came in, read the paper, and wrote underneath, 'I, Frederick, will pay these debts.' The officer awoke, read the paper, and finally decided to take it to the king, who forgave him the debt.'

ARITHMETIC.—(1) Take ¼ from the sum of ⅓ and ⅛. Ans. ⅓.

(2) If 40 men, 80 women, and 108 boys work in a factory, and every boy per week gets 5s., every woman twice as much as a boy, and every man as much as a woman and boy together, how much is paid in weekly wages? Ans. £97.

(3) If there are 5 doors in a house, each door 8 feet long, and 3½ feet wide, how much would they cost at 2s. per square yard? Ans. £2 16s.

(4) 390 at £4 1s. 2½d. each.
Ans. £1,583 11s. 3d.

(5) If a man takes 7 steps to a lad's 13, how many more would the lad take in a distance where the man took 19,500 steps? Ans. 16,714⅔.

GRAMMAR.—Analyse and parse:—

'This gallant action was severely blamed.'
'Still the danger appeared greater.'
'He might examine them more closely.'

STANDARDS V. AND VI.

MENTAL ARITHMETIC.—61 articles at 9¼d. each. Area of a room 5½ yds. × 3½ yds. ½ + ⅜. 5 ozs. tea at 3s. 4d. per lb., etc.
Ans. (1) £2 7s. 0¼d. (2) 19¼ yds. (3) ⅝. (4) 1s. 0½d.

STANDARD VI.

COMPOSITION.—Letter to inspector about 'iron,' 'gardening,' 'trees,' 'rivers,' 'mountains,' 'fish,' 'coal,' 'trade you would like to follow.' (Each boy was set a different subject.)

GRAMMAR.—Analyse and parse:—

'They have done for me at last, Hardy! said he.'
'Well we know that in our nature
Is a spark of life divine.'

ARITHMETIC.—(1) Interest on £540 8s. 6d. for 7 months at 3½ per cent. Ans. £11 0s. 8 33/100 d.
(2) Divide 4·5294 by 1·5 and take away ·9 from the answer. Ans. 2·1196.

ANSWERS TO ARITHMETICAL QUESTIONS IN 'THE SCHOLAR' FOR JANUARY, 1885.

STANDARD III.

A. 1. 19174 + 30.
2. 6748 + 103.
3. 9586 + 116.
B. 1. 152581 + 1147.
2. 23363 + 34.
3. 100137 + 733.
C. 1. £5687 15s. 3½d.
2. £73,153 11s. 4d.
3. £194,005 5s. 8½d.
D. 1. £991 10s. 10¾d.
2. £1281 18s. 10½d.
3. £27 0s. 11½d.
E. 1. £10 10s. 7d.
2. £2 17s. 11½d.
3. £1 12s. 1½d.

STANDARD IV.

A. 1. £36,581 15s. 10d.
2. £97,083 1s. 10½d.
3. £231,033 16s. 1½d.
B. 1. £2 8s. 0¾d. + 132.
2. £26 14s. 2⅜d. + 296.
3. £64 7s. 11½d.
C. 1. 3276.
2. 114,617½ yds.
3. 94,312 ins.
D. 1. £11 14s.
2. £12,872 18s. 1½d.
3. 100 cwts. 1 qr. 22 lbs.
E. 1. 365 days 11 hrs. 50 mins.
2. 19,873,609 sq. ins.
3. £2 19s. 10½d.

STANDARD V.

A. 1. 2⅞
2. 5/11.
3. ⅛.
B. 1. 42 days.
2. £21 8s. 2d.
3. Total £54 13s. 1d.
C. 1. 20 days.
2. £21 9s. 2d.
D. 1. £22 3s. 9½d. ⅝
2. £6542 8s. 1⅜d.
3. Total £43 18s. 7d.
E. 1. 15s. 4½d. + ¾.
2. £1303 5s. 10d.
3. Total £11 18s. 4½d.

STANDARD VI.

A. 1. £6 15s.
2. 17s. 1 5/16 d.
3. 1 1/11.
B. 1. 8⅜ oz.
2. (a) ·05. (b) ·125.
3. £14 8s.
C. 1. 36,000.
2. (a) £13 2s. 6d. (b) £9 7s. 6d.
3. 4/15.
D. 1. 66⅔ ac.
2. ·2083.
3. ⅓ of 8 is greater by 1/15.
E. 1. 36⅔ days.
2. £19 1s. 7d.
3. 31/39.

STANDARD VII.

A. 1. 200.
2. 11·71296.
3. 3s. 1½d.
B. 1. £646 9s. 5·9d.
2. 26¾ yrs.
3. £16 13s. 4d.
C. 1. £14 13s. 4d.
2. £1540.
3. 20 p.c.
D. 1. £1920.
2. (1) £2 12s. 4d. (2) 25 p.c.
3. (1) ·34. (2) 3·4.

THE TIN-MAKER MAN.*

T. CRAMPTON.

1st TREBLE.
2nd TREBLE.
BASS.
Jovially.
mf
1. There's mer-ry old Ro-ger, the tin-mak-er man, Who lives in a cot-tage be-low Preston-Pan; And
2. Now Ro-ger's bald pate is as smooth as your nose—When buying his stockings he pays for half-hose; He
3. If down be-low Pres-ton you hap-pen to be, There jol-ly old Ro-ger at work you may see; And
KEY G. Jovially. mf
ham-mers a-way like rain on the ground On sauce-pans and ket-tles, to make them quite sound.
has but one leg, and wears but one shoe, And stumps round his shop on a stout tim-ber-toe,
if you don't see him—quite a mile round From morn-ing to eve you may hear the bright sound.
D. t.
CHORUS.
There nev-er was yet a boy or a man Who bet-ter could mend a ket-tle or pan, A
f. G. CHORUS.
boil-er, a skim-mer, a dip-per, or can—Than mer-ry old Ro-ger, the tin-mak-er man!
p
Bang! bang! rat-tle! on sauce-pan and can, Goes mer-ry old Ro-ger, the tin-mak-er man!
f

* This may be used as an *Action Song*, by appropriate actions to the words, "bang!" "rattle!" &c.

HUMPTY DUMPTY.

Words by GEO. BENNETT. *Music by* T. CRAMPTON.

Moderato.

1st TREBLE.
2nd TREBLE.
BASS.

mf

1. Hump - ty Dump - ty sat on a wall, Hump - ty Dump - ty had a sad fall: "It
2. Hump - ty Dump - ty, tru - ant was he; Hump - ty Dump - ty, dunce he would be; He'd
3. Hump - ty Dump - ty fell from the wall, Hump - ty Dump - ty scarce - ly could crawl; They

KEY D. *Moderato. mf*

1st TREBLE.	s :- :m	s :- :m	l :s	:f	s :- :-	f :- :s	m :- :d	r :m	:f	m :- :m
2nd TREBLE.	m :- :d	m :- :d	d :d	:d	d :- :-	t_1 :- :t_1	d :- :d	d :d	:t_1	d :- :d
BASS.	d :- :d	d :- :d	f :m	:r	m :- :-	r :- :s_1	d :- :m	s :s	:s	d :- :d

served him right!" I am sure you'll say, He had no bus-'ness there at play; He should have been at
wan - der oft - en a - way from home, And thro' the woods and fields would roam: There he would saun-ter
took him home with a brok - en head, Then laid him cry - ing on the bed: There while he lay both

f *p*

A. t. *f* *f.* D. *p*

m_1 :- :s_1	s_1 :d	:s_1	l_1 :- :s_1	s_1 :- :	m :r	:d	l_1 :- :f	m :- :r	d :- :	d_s :f	:m	l :- :f
d_f :- :f_1	m_1 :m_1	:m_1	f_1 :- :f_1	m_1 :- :	s :f_1	:m_1	f_1 :- :l_1	s_1 :- :f_1	m_1 :- :	l_m :r	:d	.l :- :d
l_r :- :r_1	d_1 :d_1	:d	t_1 :- :t_1	d :- :	d_1 :r_1	:m_1	f_1 :- :r_1	s_1 :- :s_1	d_1 :- :	f_d :r	:m	f :- :l

cres. *cres.* *f*

school, you know—But there, he did not like to go! For mis - chief was his sole de - light, And
all the day, Not join the rest in health - ful play; He nev - er loved his book, not he! And
night and day, And thought what time he'd lost in play, He said, when he got well he'd turn, And

s :- :m	f :- :r	m :- :s	f :- :m	r :- :r	r :- :r	s :- :l	f :- :s	m :- :f	r :- :t
d :- :d	t_1 :- :t_1	d :- :r	d :- :d	l_1 :- :d	t_1 :- :t_1	d :- :de	r :- :r	d :- :r	t_1 :- :r
m :- :s	r :- :s	d :- :t_1	l_1 :- :s_1	f_1 :- :fe	s_1 :- :f	m :- :l_1	r :- :t_1	d :- :f	s :- :f

he was in it . morn and night.
scarce - ly knew his A B C.
go to school and try to learn.

Symph.

Symph.

d' :- :l	s :m	:-	r :- :s	d :- :	m' :- :r'	d' :- :t	d' :- :l	s :- :-	l :- :t	d'	s :- :d	m :- :r	d :- :
d :- :d	d :d	:-	d :- :t_1	d :- :	s :- :-	f :- :-	- :- :-	m :- :-	d :- :-	d	:- :d	- :- :t_1	d :- :
m :- :f	m :d	:-	s_1 :- :s_1	d :- :	d :- :r	m f :- :s	l :- :t	d' :- :-	f :- :-	m	:- :fe	s :- :f	m :- :
													:s_1	d :- :

Query Column.

RULES.

1. Each correspondent is restricted to *one question.* We should be much obliged if correspondents, who send questions for solution, would give (if possible) the required answer, and the source from which the question is obtained.

2. No query can be answered unless accompanied by the real name and address of the sender, not necessarily for publication, but as a guarantee of good faith and for facility of reference.

3. ☞ When a pseudonym is adopted it should be written at the end of the query, and the real name and address on a separate piece of paper.

4. Correspondents are requested to write their queries *legibly*, and on one side of the paper only.

5. Replies will not be sent through the post.

6. Queries must reach the office *not later than the 12th of the month*, or they cannot be attended to in the following issue.

*** All communications for this column should be addressed—'*The Query Editor*,' *The Practical Teacher*, *Pilgrim Street, Ludgate Hill, London, E.C.*

Arithmetic.

1. AGONISTES.—A man has 30 cattle, by which he hopes to make a certain profit per cent.; but he loses 10 suddenly by the cattle plague, and his loss is now as great as the profit would have been. Find the percentage of loss. (*Piper.*)

$$30 \times \frac{\text{Percentage}}{100} = 30 - \left\{ (30-10) \times \frac{100+\text{Percentage}}{100} \right\},$$

$$\frac{3 \text{ times Percentage}}{10} = 30 - \frac{100+\text{Percentage}}{5},$$

3 times Percentage = 300 − 200 − Twice Percentage,

3 times Percentage + Twice Percentage = 100,

5 times Percentage = 100,

∴ Percentage = 20. Ans.

2. NOTNAPS.—By selling out New-Zealand 5 per cents. at 103½ and investing in the 6 per cents. at 112½ an increase of £4 17s. 6d. in income was obtained; what was the amount sold out?

Income on £100 stock in the 5 per cents. = £5;

Income on this amount when transferred to the 6 per cents.

$$= £6 \times \frac{103\frac{1}{2}}{112\frac{1}{2}}$$
$$= £6 \times \frac{207}{225}$$
$$= £5\frac{23}{25};$$

Increase in income = $£\frac{2}{25}$;

∴ Amount sold out = $£100 \times \frac{£4\frac{7}{2}}{£\frac{2}{25}}$

$$= £\left(\frac{25}{\cancel{100}} \times \frac{\overset{3}{\cancel{9}}}{\cancel{8}} \times \frac{\overset{25}{\cancel{75}}}{\cancel{2}}\right)$$
$$= £\frac{1875}{2}$$
$$= £937\ 10s.$$ Ans.

3. ANNIE LINDSAY.—A man invested a sum of money in the 3 per cent. Consols at 88, and at the end of 4½ months, after receiving one-half year's dividend, sold out at 87½. At what rate per cent. per annum did he receive interest on his capital? (*Cambridge Senior*, 1873.)

£	£	
88	100	
months	year	:: (½ of £3 − ½ £) : Rate %
4½	1	
22	25	
3	8	:: £1 : Rate %

∴ Rate per cent. $= \frac{25 \times \overset{4}{\cancel{8}}}{\cancel{22} \times 3}$

$$= \frac{100}{33}$$
$$= 3\frac{1}{33}.$$ Ans.

Note.—The other question was solved in our last issue.

4. F. S.—Find the three highest integral numbers whose sum is under a million, so that the first may be to the second as 5 yds. 2 ft. 6 ins. is to 5 yds. 3 qrs. 2½ nls., and the second may be equal to $\frac{3 \text{ cwt. } 3 \text{ qrs. } 12 \text{ lbs.}}{4 \text{ cwt. } 2 \text{ qrs. } 16 \text{ lbs.}}$ of the third. (*Brook-Smith.*)

	yds.	ft.	in.		yds.	ft.	nls.
First No. : Second ::	5	2	6	:	5	3	2½
	3				4		
	17 ft.				23 qrs.		
	12				4		
	210 in.				94½ nls.		
					2½		
					189		
					23½		
					212½ in.		

∴ First No. : Second No. :: 1680 : 1701;

	cwt.	qrs.	lbs.		cwt.	qrs.	lbs.
Second No. : Third No. ::	3	3	12	:	4	2	16
	4				4		
	15				18		
	28				28		
	432				520		

∴ Second No. : Third No. :: 54 : 65;

∴ First No. : Second No. : Third No.

:: 1680 : 1701 : $\frac{54}{65}$ of 1701,

:: 1680 : 1701 : $\frac{1134}{1365}$,

:: 3360 : 3402 : 4095;

G. C. M. of 3360, 3402, 4095 = 21;

Sum of $\frac{3360}{21}$, $\frac{3402}{21}$, and $\frac{4095}{21}$

= 160 + 162 + 195

= 517;

517)1000000(1934

517

4830

4653

1770

1551

2190

2068

122

∴ The three Nos. = 1934 × 160, 1934 × 162, and 1934 × 195

= 309,440, 313,308, and 377,130. Ans.

5. W. DISNEY.—In 100 yds. race A beats C by 8 yds.; in 220 yds. B beats C by 12 yds. In a quarter of a mile handicap A has 10 yds., how much ought B to have? (*Scholarship.*)

While C runs 92 yds. A runs 100 yds.,

" " " 208 " B " 220 " ,

∴ While B runs 220 yds. A runs $\frac{100 \times \overset{52}{\cancel{208}}}{\cancel{92}\ 23}$ yds.

$$= \frac{5200}{23} \text{ yds.}$$
$$= 226\frac{2}{23} \text{ yds.};$$

yds. yds. yds.

∴ $226\frac{2}{23}$: (440 − 10) :: (226⅔ − 220) : Start A should give B;

yds. yds. yds.

$226\frac{2}{23}$: 420 :: $6\frac{2}{23}$: Start A should give B;

23	23
5290	140
26	7

$= \frac{301}{10}$ yds.
$= 11\frac{1}{10}$ yds.;

∴ B should have $(11\frac{1}{10} + 10)$ yds.
$= 21\frac{1}{10}$ yds. Ans.

6. PUZZLED.—What sum invested in the 3 per cents. at 90 will amount to £2317 in $23\frac{1}{2}$ years, simple interest?

$£90 + (£3 \times 23\frac{1}{2}) = £90 + £70\frac{1}{2} = £160\frac{1}{2}$;

£ £ £
∴ 160½ : 2317 :: 90 : Sum invested.
2 2 30
321 4634
107 30
139020
£1299 5s. $0\frac{60}{107}$d. Ans.

Note.—The above is simpler than your solution. The second answer is derived thus:—Amount gained on an investment of £90 on selling out = £6; yearly interest = £3; ∴ Time = (6 ÷ 3) or 2 years.

The error in your solution is the following:—You cannot make a simple proportion sum of the two amounts and the time. You must find the time that $£\frac{2317}{107}$ will take to obtain $£(\frac{2317}{107} - £\frac{2300}{107})$ interest in the 3 per cents. at 90, and this you will find to be 2 years.

Why do you take such a roundabout way to arrive at the result?

7. TUTUS DUM RECTUS.—A man wishes to have his library arranged on shelves, each containing the same number of volumes. He tries successively to put 15, 16, and 17 volumes on each shelf, and each time he has 3 volumes remaining. If the number of volumes in his library be the least number of volumes for which this would be the case, show that he cannot arrange in the way that he desires, except upon shelves which each contains three volumes. (*Cambridge Local Examination.*)

Least No. = (L. C. M. of 15, 16, and 17) + 3
= 4080 + 3
= 4083;
4083 = 3 × 1361;

As 1361 is a prime No., he can only arrange them in shelves containing 3 or 1361.

8. HOSTIS.—Divide 488 guineas among 7 men, 9 women, and 3 boys, so that each woman may have $\frac{3}{4}$ of each man's share, and each boy $\frac{2}{3}$ of each woman's share. (*Barnard Smith.*)

Men's share : Women's share : Boys' share.
::7 : $\frac{3}{4} \times 9$: $\frac{2}{3}$ of $\frac{3}{4} \times 3$,
::7 : $\frac{27}{4}$: $\frac{1}{2}$,
::7 × 35 : 27 × 7 : 54,
::245 : 189 : 54;
245 + 189 + 54 = 488:

∴ Men's share = 245 guineas
Women's ,, = 189 ,,
Boys' ,, = 54 ,,
} Ans.

9. PRÆCEPTOR.—The receipts of a railway company are proportioned as follows:—48 per cent. for working expenses, 10 per cent. for reserve fund, a guaranteed dividend of 5 per cent. on one-fifth of the capital, and the remainder £32,000 for division amongst the holders of the rest of the stock, being a dividend a the rate of 4 per cent. per annum. Find the capital and the receipts. (*Johnstone's* 'Civil Service Arithmetic.')

Capital = £32,000 × $\frac{100}{4} \times \frac{5}{1}$
= £2000 × 500
= £1,000,000. Ans.

Receipts = (£32,000 + 5 % on ½ of £1,000,000) × $\frac{100}{100 - (48 + 10)}$
= (£32,000 + £10,000) × $\frac{100}{42}$
= £42,000 × $\frac{100}{42}$
= £100,000. Ans.

10. CHARLIE.—Find the G.C.M. and L.C.M. of ½, ¾, ⅞, and ⅝, and also of $3\frac{1}{2}$, $4\frac{1}{2}$, $6\frac{1}{2}$, and $8\frac{3}{4}$. (*Moffatt's* 'Test Cards for Pupil Teachers.')

½, ¾, ⅞, ⅝;
G.C.M. of Numerators = 1
L.C.M. ,, Denominators = 60
} ∴ G.C.M. = $\frac{1}{60}$.
L.C.M. of Numerators = 60
G.C.M. ,, Denominators = 1
} ∴ L.C.M. = 60.

$3\frac{1}{2}$, $4\frac{1}{2}$, $6\frac{1}{2}$, $8\frac{3}{4} = \frac{15}{2}, \frac{25}{6}, \frac{45}{8}, \frac{35}{4}$;
G.C.M. of Numerators = 1
L.C.M. ,, Denominators = 120
} ∴ G.C.M. = $\frac{1}{120}$.
L.C.M. of Numerators = 19,600
G.C.M. ,, Denominators = 1
} ∴ L.C.M. = 19,600.

11. WELSHMAN.—A snail creeps 2·583 feet up a pole in 12 hours of night, and slips down 1·3 feet in 12 hours of day; what length of time will it take him to get to the top of a pole 7 ft. high? (*Blackie's* 'Arithmetic.')

$2\cdot5183 = 2\frac{583 - 58}{900} = 2\frac{525}{900} = 2\frac{7}{12}$;

The snail advances $(2\frac{7}{12} - 1\frac{1}{4})$ ft. or $1\frac{1}{4}$ ft. in every 24 hours, except for the part left after the last day;

7 ft. ÷ $1\frac{1}{4}$ ft. = $\frac{7 \times 4}{5} = \frac{28}{5} = 5\frac{3}{5}$;

As the snail creeps up $2\frac{7}{12}$ ft. during the night, $(1\frac{1}{4}$ ft. × $1\frac{1}{4})$ or 2 ft. remain after 4 days;

Time to creep up the last 2 ft. = $\frac{2 \text{ ft.}}{2\frac{7}{12} \text{ ft.}}$ of 12 hrs.
= $\frac{24}{31}$ of 12 hrs.
= $\frac{288}{31}$ hrs.
= $9\frac{9}{31}$ hrs.;
∴ Total time = 4 days $9\frac{9}{31}$ hrs.
= $105\frac{9}{31}$ hrs. Ans.

12. BRUCE.—The number of coins in a bag is 150, consisting of sovereigns, half-crowns, and shillings. If the sum represented by the half-crowns and shillings be equal to that represented by the sovereigns, and the number of sovereigns be two-thirds that of the half-crowns, find the number of the different coins. (*Hamblin Smith.*)

For every 6 half-crowns, there are 4 sovereigns;
Amount for the shillings = £4 − (2s. 6d. × 6)
= £4 − 15s.
= £3 5s.;
∴ No. of shillings = 65;
Total No. of coins = 4 + 6 + 65
= 75;
∴ No. of sovereigns = $4 \times \frac{150}{75}$
= 8;
,, half-crowns = 12;
,, shillings = 130.

Note.—Perhaps 65 per cent. There is plenty of room for improvement.

13. LIVERPOOL.—A pays B a debt a year before it is due, mercantile discount being allowed. If B had waited for payment till the end of the year, he would then, money supposed to produce 5 per cent. interest, have been £5 richer than by the actual arrangement. Determine the amount of A's debt.

Difference for £100 = £5 − 5% on £95
= £5 − £4 15s.
= 5s.;

∴ Amount of debt = £100 × $\frac{£5}{5s.}$
= £100 × 20
= £2000. Ans.

14. SUDBURY.—A sum of money was put out at compound interest. The first year's interest was £65 2s. 1d., and the fourth year's interest was £73 4s. 8d. What was the sum and the rate per cent.? (*Brook-Smith.*)

Let P stand for the principal in pounds, and R for the amount of £1 in one year;

Then, (1) $PR - P = £65\frac{1}{48}$
(2) $PR^4 - PR^3 = £73\frac{7}{30}$

(1) $P(R-1) = £\frac{3138}{48}$
(2) $PR^3(R-1) = £\frac{2192}{30}$
$\frac{PR^3(R-1)}{P(R-1)} = \frac{£\frac{2192}{30}}{£\frac{3138}{48}}$

$$R^3 = \frac{2197}{125} \times \frac{8}{3125}$$

$$= \frac{17576}{390625}$$

$$= 1{\cdot}124864$$

$$\therefore R = \sqrt[3]{1{\cdot}124864}$$

$$\therefore 1{\cdot}124\,864(1{\cdot}04$$

$$1$$

$$10^2 \times 300 = 30000 \quad | \quad 124864$$
$$10 \times 30 \times 4 = 1200$$
$$4^2 = 16$$
$$31216 \quad | \quad 124864$$

$$\therefore R = 1{\cdot}04$$

Interest on £1 = £·04,
∴ „ „ £100 = £4.

(1) $P(R-1) = £^{3}_{11}$
$P(1{\cdot}04 - 1) = £^{3}_{11}$
$P \times {\cdot}04 = £^{3}_{11}$
$\therefore P = £(^{3}_{11} \times 25)$
$= £^{75}_{11}$
$= £1627\ 12s.\ 1d.$

∴ Principal = £1627 12s. 1d., and rate per cent. = 4.

15. LAUGHING HYENA.—The Gregorian method of reckoning time omits a day in 133·333 years. We ought really to omit a day in 128·471 years. In what time will the error amount to one day? (*Barter.*)

Time for error to amount to one day
$= (133{\cdot}333 \div \frac{133{\cdot}333 - 128{\cdot}471}{128{\cdot}471}$ years)
$= \frac{133{\cdot}333 \times 128{\cdot}471}{4{\cdot}862}$ years
$= \frac{17129{\cdot}423843}{4{\cdot}862}$ years
$= 3{,}523{\cdot}1229\ldots$ years. Ans.

16 F. COATES.—The diameters of four spheres are to one another as 3·75 : 5 : 6·25 : 7·5, and the volumes of spheres vary as the cubes of their diameters. Prove that the greatest of these four spheres is equal to the other three together? (*Lower Division, Men Clerks*, May, 1884.)

Ratio of 3·75 : 5 : 6·25 : 7·5,
(Dividing by 1·25)
= Ratio of 3 : 4 : 5 : 6;
$3^3 + 4^3 + 5^3$
$= 27 + 64 + 125$
$= 216$
$= 6^3$.

∴ Solidity of greatest = Solidity of the other three together.

17. BA-BURN.—The weight of a shilling being 87 grains, find the weight of a sovereign, the diameter of a sovereign being to that of a shilling as 57 to 60, the thickness as 21 to 22, and gold being heavier than silver in the proportion of 32 to 19. (The area of a circle varies as the square of its diameter.) (*Lower Division*, February, 1884.)

$60^2 : 57^2$
$22 : 21$
$19 : 32$
} :: 87 : Weight of sovereign,

$$= \frac{\overset{3}{\cancel{87}} \times 57 \times \overset{1}{\cancel{21}} \times \overset{7}{\cancel{22}} \times 87}{\underset{5}{\cancel{60}} \times \underset{5}{\cancel{60}} \times \underset{11}{\cancel{21}} \times \underset{1}{\cancel{19}}} \text{ grains.}$$

$$= 3\tfrac{1388}{11}\text{ grains.}$$
$$= \frac{1388{\cdot}52}{11}\text{ grains.}$$
$$= 126{\cdot}2260\text{ grains.}$$ Ans.

18. ARISTARCHUS.—The rates of two bicyclists are as 11 to 8. They start together from the winning-post, and race round and round a circuit of 480 yards. It is noticed that the best man passes the other every 4 minutes, and that at the moment when the race ends they are passing the winning-post for the first time together.

How long did the race last, and how many minutes' start can the best man afford to give in a 9-mile race, without losing? (*Cambridge Higher Local Examination*, June, 1884.)

$\frac{11-8}{11}$ of rate per min. of best man × 4 = 480 yds.,
$\frac{3}{11}$ of rate per min. of best man = 120 yds.,
∴ Rate per min. of best man = (120 × $\frac{11}{3}$) yds.
= 440 yds.;
∴ „ „ „ other „ = $\frac{8}{11}$ of 440 yds.
= 320 yds.;
∴ Race lasted $\frac{480 \times (11+8)}{440}$ min.
$= \frac{12 \times 19}{11}$ min.
$= 20\frac{8}{11}$ min. Ans.

The best man can ride 9 miles in (9 ÷ $\frac{1}{4}$) min.
= 36 min.;
„ other „ „ „ „ „ $\frac{9 \times 1760}{320}$ min.
= 49½ min.;

∴ The best man can win a 9-mile race by 13½ min., and can therefore afford to give a start of any time under 13½ min.

19. CYMRO.—A sum of £1640 is borrowed, to be paid back in two years by two equal annual payments, allowing 5 per cent. compound interest. Find the annual payment. (*London Matriculation, June*, 1884.)

£ £ £
$\frac{105}{21} : \frac{105}{20} :: 100$: Debt for a payment of £100 the first year.
$= \frac{2000}{21}$ £.

£ £ £
$110\frac{1}{2} : 100 :: 100$: Debt for a payment of £100 the second year.
$= \frac{40000}{441}$ £.

Amount of debt for annual payments of £100
$= (\frac{2000}{21} + \frac{40000}{441})$£
$= \frac{42{,}000 + 40{,}000}{441}$ £
$= \frac{82000}{441}$ £.

∴ $£^{82000}_{441} : £1640 :: £100$: Annual payment.

$$= \frac{\overset{2}{\cancel{1640}} \times \overset{1}{\cancel{164}} \times 441}{\underset{1}{\cancel{82}} \times \underset{1}{\cancel{82}} \times \underset{1}{\cancel{100}}} £$$

$= £882$. Ans.

20. TYKE.—What rate of interest does a person obtain by purchasing shares in the Glasgow and South Western Railway at £72, the annual dividend being 7 per cent., and the original value of a share being £50? (*Chambers' Educational Course.*)

Annual dividend on a share = ¼ of £7 = £3½;
(Brokerage = ½ £ on a share.)
£ £ £
∴ $72\frac{1}{2} : 100 :: 3\frac{1}{2}$: Rate of interest.

$$= \left(\frac{100}{1} \times \frac{7}{2} \times \frac{4}{577}\right) £$$

$$= \frac{2800}{577} £$$

$= 4\frac{332}{577}$ per cent. Ans.

21. SCRIBBLER.—A person transfers £1000 stock from the 4 per cents. at 90 to the 3 per cents. at 72; find the alteration in his income. (*Barnard Smith.*)

Income in 1st case = 4 per cent. on £1000
= £40;

Stock in 2nd case $= £\left(\frac{250}{\underset{1}{\cancel{144}} \times \underset{72}{\cancel{96}}}\right)$
$\overset{5}{\cancel{250}}$
$\overset{4}{\cancel{72}}$
= £1250;
Income „ „ = 3 per cent. on £1250
= £37 10s.;
∴ Alteration in income = (£40 − £37 10s.) decrease.
= £2 10s. decrease. Ans.

22. MONTGOMERIE.—A company with a subscribed capital of 5000 shares, £10 paid, after paying expenses of management

£950, and income-tax at 9d. in the pound, divides 5 per cent. to the shareholders; what were the gross returns? (*Davis.*)

Amount paid to shareholders = 5 per cent. on £50,000
= 2500;

$$\therefore \text{Gross returns} = \left(£2500 \times \frac{240}{231}\right) + £950$$

$$= £\frac{200000}{77} + £950$$
$$= £2597\ 8\tfrac{4}{7}\text{s.} + £950$$
$$= £3547\ 8\tfrac{4}{7}\text{s.}\ \text{Ans.}$$

Note.—Your writing is *pretty good*, but you do not join the letters. Perhaps 85 per cent.

23. MOCHYN DHU.—In what time will £400 amount to £467 18s. 10·42176d., at 4 per cent. compound interest?

£467 18s. 10·42176d.
= £467·943424;
Amount of £1 at end of required time
= £467·943424 ÷ 400
= £1·16985856;

Now amount of £1 for 1 year at 4 per cent. = £1·04; and if we multiply this (1·04) by itself until we obtain 1·16985856, we shall obtain the number of years.

$(1{\cdot}04)^4 = 1{\cdot}16985856$;
Hence required time = 4 years. Ans.

24. H. T.—The strength of one horse is to the strength of another as 9 is to 7. At what point ought the six-feet long cross-bar, at the end of which they are pulling, to be attached to the load, so that each may have a share of the draught proportioned to its strength? (*Cassell's* 'Saturday Journal.')

$$\text{Distance from stronger horse} = 6 \text{ ft.} \times \frac{7}{7+9}$$
$$= 6 \text{ ft.} \times \tfrac{7}{16}$$
$$= \tfrac{21}{8} \text{ ft.}$$
$$= 2 \text{ ft. } 7\tfrac{1}{2} \text{ in. Ans.}$$

25. G. F. A., BOLDMERE.—From one mile take 7 furlongs, 39 poles, 5 yards, 1 foot, 5 inches. Explain the difficulty. (*Government Inspection, Standard IV.*)

$5\frac{1}{2}$ yards, or 5 yards, 1 foot, 6 inches = 1 pole;
∴ Difference = 1 inch. Ans.

Pupils will find a difficulty in working it by the ordinary method, as they will obtain 1 foot 7 inches, and will then have to subtract 6 yards from $5\frac{1}{2}$ yards.

26. J. EDWARDS.—A person sold a certain quantity of 3 per cent. stock at 95. He invested half the proceeds in 5 per cent. railway bonds at 106, and the other half in mortgage at $4\frac{1}{2}$ per cent. The brokerage for transfer of stock amounted to £2 9s. 8½d., and the cost of drafting and executing the mortgage deed was £15. After these charges had been paid out of the first year's income there remained 15s. 6d. more than the previous income from 3 per cent. stock. How much of this stock was sold?

Suppose £10,600 stock was sold out;
Then amount realised = (95 × 106)£
= £10,070;

Income in 1st case = 3 per cent. on £10,600
= £318;
" " 2nd " = £(5035 × $\frac{8}{112}$)
+ $4\frac{1}{2}$ per cent. on £5035
= £$\frac{4}{7}$ + £$\frac{202}{40}$
= £237 10s. + £226 11s. 6d.
= £464 1s. 6d.;

Difference of incomes = £464 1s. 6d. − £318
= £146 1s. 6d.;

Difference of incomes in the question
= £2 9s. 8½d. + £15 + 15s. 6d.
= £18 5s. 2½d.;

£	s.	d.	£	s.	d.	£
146	1	6	18	5	2½	10070
20			20			
2921			365			
12			12			
35065			4382			
			4			
			17529			

∴ : : : Amount of stock sold out.

= £$\frac{35065}{4}$ stock
= £8766 stock. Ans.

27. R. B.—The areas of two water-pipes attached to different cisterns are to one another as $2\frac{1}{2}$ is to 3. The smaller has been running for 3 hours, when the larger also begins to flow. Suppose that at the end of every hour thereafter an additional pipe, with an area of one-sixth of the larger of the pipes already mentioned, begins to flow from the same cistern as the larger pipe is attached to; how many hours will have elapsed from the time of starting of the larger pipe before the quantities of water drawn from each cistern will be the same? (*Cassell's* 'Saturday Journal.')

Suppose quantity emptied by larger pipe in an hour
= 600 gals.;
Then, quantity emptied by smaller pipe in an hour
= 500 gals.;
Quantity emptied by smaller pipe in 3 hours = 1500 gals.;
Quantity gained in 1st hour after larger pipe is opened
= 100 gals.;
Quantity gained in 2 hours = 100 gals. × 2 + $\frac{1}{6}$ of 600 gals.
= 300 gals.;
" " 3 " = 100 gals. × (3+2+1)
= 600 gals.;
" " 4 " = 100 gals. × (4+3+2+1)
= 1000 gals.;
" " 5 " = 100 gals. × (5+4+3+2+1)
= 1500 gals.;
∴ Time = 5 hours. Ans.

28. ARCHIE.—A tradesman sells goods, either for cash at a discount at $2\frac{1}{2}$ per cent., or at 4 months' credit. If I buy goods worth £31 10s., and pay half of the sum in ready money, taking credit for the rest, what will the goods cost me? (*Cornwell and Fitch.*)

$\frac{1}{2}$ of £$2\frac{1}{2}$ = £$\frac{5}{4}$,

£	£	s.	£
100	15	15	$\frac{5}{6}$

∴ : : : Discount.

6 × 20 = 120; 315 ÷ 121 = 2 (2s.); 242; 73; × 12 = 876; 847 (7d.); 29

∴ Cost of goods = £31 10s. − 2s. $7\frac{29}{121}$d.
= £31 7s. $4\frac{92}{121}$d. Ans.

Mensuration.

1. C. LODGE.—A mirror is (20 × 18) inches, including frame, which is $\frac{1}{5}$ of the whole area. Find width of frame. (*Boucher.*)

Area of frame = [½(20+18) − 4 times width] × width] square inches;

∴ (76 − 4 times width) × width = $\frac{1}{5}$ of 20 × 18,
− 4 times width² × 76 times width = 72,
Width² − 19 times width = − 18,

Completing the square: Width² − 19 times width + $(\frac{19}{2})^2$ = $\frac{361}{4}$ − 18
= $\frac{361-72}{4}$
= $\frac{289}{4}$;

Extracting square root, Width − $\frac{19}{2}$ = ± $\frac{17}{2}$
Width = ± $\frac{17}{2}$ + $\frac{19}{2}$
= 18, or 1.
∴ Width of frame = 1 inch.

2. NEURASERUPONSKELESTERIZO.—One side of a triangle is 15 ft.; it is required to divide the triangle into 5 equal parts by straight lines parallel to one of the other sides; find the distances from the vertex of the points of division of the given side. (*Todhunter.*)

(First part)² : 15² : : 1 : 5,
(First Part)² = 45,
∴ First Part = $\sqrt{45}$
= 6·7082... ft.

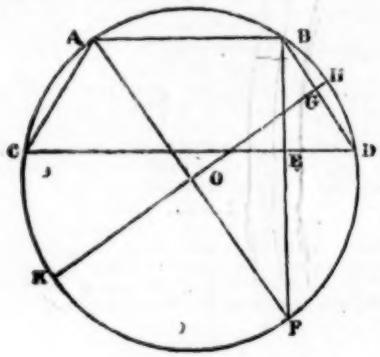
(First and Second Parts)^2 : 15^2 :: 2 : 5,
(First and Second Parts)^2 = 90,
∴ First and Second Parts = $\sqrt{90}$
= 9·4868...ft.

First, Second, and Third Parts = $\sqrt{45\times3}$
= $\sqrt{135}$
= 11·6189...ft.

First, Second, Third, and Fourth Parts = $\sqrt{45\times4}$
= $\sqrt{180}$
= 13·4164...ft.

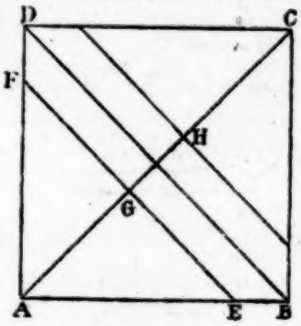
Note.—*Bright's* 'Constitutional Monarchy.' Price 7s. 6d. (Rivingtons.)

3. H. B., L. H.—What is the area of a zone whose greater side measures 72 feet, the less 45 feet, and breadth 19 feet 6 inches? (*Nesbit.*)



$ED = \frac{1}{2}(CD - AB)$
$= \frac{1}{2}(72 - 45)$
$= 13{\cdot}5$;
$CE \times ED = BE \times EF$, (III. 35);
$(72 - 13{\cdot}5) \times 13{\cdot}5 = 19{\cdot}5 \times EF$
$EF = \frac{58{\cdot}5 \times 13{\cdot}5}{19{\cdot}5}$
$= 40{\cdot}5$;
$BF = 19{\cdot}5 + 40{\cdot}5 = 60$;
$AF^2 = AB^2 + BF^2$, (I. 47.)
$= 45^2 + 60^2$
$= 2025 + 3600$
$= 5625$;
∴ $AF = \sqrt{5625}$
$= 75$. (Diameter of circle.)
$BG \times GD = KG \times GH$,
$BG^2 = (75 - GH) \times GH$
$\frac{1}{4}BD^2 = 75GH - GH^2$,
$\frac{1}{4}(19{\cdot}5^2 + 13{\cdot}5^2) = 75GH - GH^2$,
$\frac{562{\cdot}5}{4} = 75GH - GH^2$,
$GH^2 - 75GH = -\frac{562{\cdot}5}{4}$
$GH^2 - 75GH + \left(\frac{75}{2}\right)^2 = \frac{5625 - 562{\cdot}5}{4}$
$= \frac{5062{\cdot}5}{4}$
$GH - \frac{75}{2} = \pm\frac{71{\cdot}15\ldots}{2}$
$GH = \frac{75 \pm 71{\cdot}15}{2}$
$= \frac{146{\cdot}15}{2}$, or $\frac{3{\cdot}85}{2}$
∴ $GH = 1{\cdot}925$.
$\frac{\text{Height of segment}}{\text{Diameter of circle}} = \frac{1{\cdot}925}{75} = {\cdot}0256$;
Tabular area of segment answering to this is ·005419;
∴ Area of segment $BHD = {\cdot}005419 \times 75^2$
$= {\cdot}005419 \times 5625$
$= 30{\cdot}4818875$;
Area of trapezoid $ACDB = \frac{1}{2}(AB + CD) \times BE$
$= \frac{1}{2}(45 + 72) \times 19{\cdot}5$
$= 58{\cdot}5 \times 19{\cdot}5$
$= 1140{\cdot}75$;
∴ Area of zone = {1140·75 + (30·481875 × 2)} sq. ft.
= (1140·75 + 60·96375) sq. ft.
= 1201·71375 sq. ft. Ans.

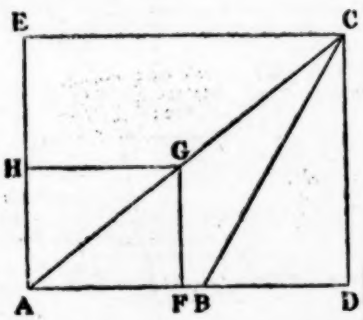
4. BETA.—The side of a square is 12 feet; the square is divided into three equal parts by two straight lines parallel to a diagonal; find the perpendicular distance between the parallel straight lines. (*Todhunter.*)



$\frac{AE \times AF}{2} = \frac{AB^2}{3}$,
$\frac{AE^2}{2} = \frac{12^2}{3}$
$= 48$,
$AE^2 = 96$;
$AG^2 + GE^2 = AE^2$,
$2AG^2 = 96$,
$AG^2 = 48$,
∴ $AG = \sqrt{48}$.
$GH = AC - (AG + CH)$,
$= \sqrt{2AB^2} - 2AG$
$= \sqrt{2 \times 12^2} - 2\sqrt{48}$
$= \sqrt{288} - \sqrt{192}$
$= 16{\cdot}9705\ldots - 13{\cdot}8563\ldots$
$= 3{\cdot}114\ldots$
∴ Perpendicular distance = 3·114...ft.

Geometry.

1. VELLSERP.—Bisect the given triangle ABC by a line perpendicular to AB.



From C draw CD perpendicular to AB produced, and complete the rectangle ADCE.

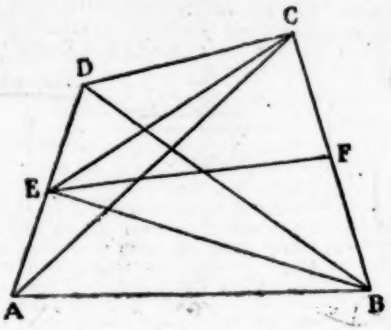
Describe a rectangle AFGH similar to ADCE, and equal to the triangle ABC, so that F may be on AD, and H on AE. (VI. 25.)

Then G will fall on AC. (VI. 26.)

Proof.—Triangle AFG is half the rectangle AFGH, and is therefore equal to half the triangle ABC.

Wherefore the perpendicular FG bisects the triangle ABC.
Q. E. F.

2. BOLDMERE.—In any trapezium, if the opposite sides be bisected, the sum of the squares on the other two sides, together with the squares on the diagonals, is equal to the sum of the square on the bisected sides, together with four times the square on the line joining the points of bisection. (*Potts.*)



Let ABCD be a trapezium, and EF the line joining the middle points of AD and BC.

Then, $AB^2+CD^2+AC^2+BD^2=AD^2+BC^2+4EF^2$.

Proof.—Because E is the middle point of AD in the triangle ACD,

$$AC^2+CD^2=2AE^2+2CE^2;$$

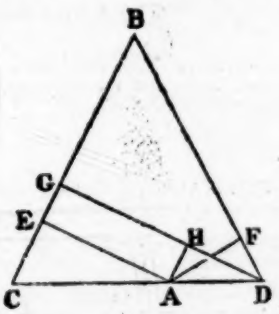
For the same reason,

$$AB^2+BD^2=2AE^2+2BE^2;$$

$\therefore AB^2+CD^2+AC^2+BD^2=4AE^2+2BE^2+2CE^2$;
But, $4AE^2=AD^2$;
And, $BE^2+CE^2=2BF^2+2EF^2$,
$\therefore 2BE^2+2CE^2=4BF^2+4EF^2$;
But, $4BF^2=BC^2$;
$\therefore AB^2+CD^2+AC^2+BD^2=AD^2+BC^2+4EF^2$.

Q. E. D.

3. WILL-O'-THE-WISP.—The sum of the perpendiculars, drawn from the point A in the base of an isosceles triangle to the opposite sides, is equal whatever be the position of A.



Let BCD be an isosceles triangle, and let AE, AF be the perpendiculars from a point A in the base to the opposite sides, then the sum of AE and AF is constant.

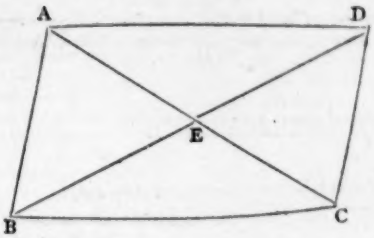
Draw DG parallel to AE, and AH parallel to BC, meeting DG in H.

Proof.—AEGH is a parallelogram,

$\therefore$ AE=GH. (I. 34.)
In the triangles AFD, DHA,
The angles FDA, HAD are equal;
For $\angle FDA=\angle BCD$, (I. 5.)
And $\angle HAD=\angle BCD$; (I. 29.)
The angles AFD, DHA are equal, (Ax 11.)
And the side AD is common,

$\therefore$ Side AF=Side DH; (I. 26.)
Wherefore sum of AE and AF is equal to DG;
$\therefore$ The sum of the perpendiculars is constant. Q. E. D.

4. CONSTANT SUBSCRIBER.—The diagonals of a parallelogram bisect each other.



Let ABCD be a parallelogram, and let the diagonals AC, BD intersect in E.

Then AC and BD shall be bisected at E.

Proof.—In the triangles AEB, CED,
$\angle$s EAB, EBA = $\angle$s ECD, EDC, (I. 29.)
And side AB = side CD; (I. 34.)
$\therefore$ Side AE = side EC,
and side BE = side DE. (I. 26.) Q. E. D.

Algebra.

1. UNITY.—Find the value of

$$\frac{x-1}{x+1}+\frac{x+3}{x-3}-2\frac{x+2}{x-2}, \text{ when } x=5.$$

(*Jones and Cheyne.*)

$$\frac{x-1}{x+1}+\frac{x+3}{x-3}-2\frac{x+2}{x-2}, \text{ (when } x=5)$$
$$=\frac{5-1}{5+1}+\frac{5+3}{5-3}-2\frac{5+2}{5-2}$$
$$=\frac{4}{6}+\frac{8}{2}-2\times\frac{7}{3}$$
$$=\frac{2}{3}+4-4\frac{2}{3}$$
$$=0. \text{ Ans.}$$

2. BAPTISTA.—Solve :—

$$9\sqrt{x^2-9x+28}+9x=x^2+36.$$

(*Todhunter's* 'Algebra for Beginners.')

$$9\sqrt{x^2-9x+28}+9x=x^2+36$$
$$-x^2+9x+9\sqrt{x^2-9x+28}=36$$
$$x^2-9x-9\sqrt{x^2-9x+28}=-36$$
$$(x^2-9x+28)-9\sqrt{x^2-9x+28}=-36+28$$
$$=-8$$
$$(x^2-9x+28)-9\sqrt{x^2-9x+28}+(\tfrac{9}{2})^2=\tfrac{81}{4}-8$$
$$=\tfrac{49}{4}$$
$$\sqrt{x^2-9x+28}-\tfrac{9}{2}=\pm\tfrac{7}{2}$$
$$\sqrt{x^2-9x+28}=\pm\tfrac{7}{2}+\tfrac{9}{2}$$
$$=8, \text{ or } 1$$
$$x^2-9x+28=64, \text{ or } 1$$
$$x^2-9x=36, \text{ or } -27$$
$$x^2-9x+(\tfrac{9}{2})^2=\tfrac{81}{4}+36, \text{ or } \tfrac{81}{4}-27$$
$$=\tfrac{225}{4}, \text{ or } -\tfrac{27}{4}.$$

$\therefore x-\frac{9}{2}=\pm\frac{15}{2}$ (as we cannot take the square root of a negative quantity.)

$$x=\pm\tfrac{15}{2}+\tfrac{9}{2}$$
$\therefore x=12, \text{ or } -3.$ Ans.

3. UNITY.—Solve :—

$$\frac{1}{x}+\frac{1}{x+1}=\frac{6}{5}. \quad (\textit{Mansford.})$$

$$\frac{1}{x}+\frac{1}{x+1}=\frac{6}{5}$$
$$6(x+1)+6x=5x(x+1)$$
$$6x+6+6x=5x^2+5x$$
$$5x^2+5x-12x=6$$
$$5x^2-7x=6$$
$$x^2-\frac{7x}{5}=\frac{6}{5}$$
$$x^2-\frac{7x}{5}+(\tfrac{7}{10})^2=\tfrac{6}{5}+\tfrac{49}{100}$$
$$=\frac{120+49}{100}$$
$$=\tfrac{169}{100}$$

$$x-\tfrac{7}{10}=\pm\tfrac{13}{10}$$
$$x=\pm\tfrac{13}{10}+\tfrac{7}{10}$$
$$\therefore\ \underline{x=2,\text{ or }-\tfrac{3}{5}}.\ \text{Ans.}$$

4. PROSPERO.—Find the H.C.F. of $21x^2-83xy-27x+22y^2+99y$, and $12x^2-35xy-6x-33y^2+22y$. (*Hamblin Smith.*)

$$21x^2+83xy-27x+22y^2+99y$$
$$=21x^2-83xy+22y^2-27x+99y$$
$$=(3x-11y)(7x-2y)-9(3x-11y)$$
$$=\underline{(3x-11y)(7x-2y-9)}.$$

$$12x^2-35xy-6x-33y^2+22y$$
$$=12x^2-35xy-33y^2-6x+22y$$
$$=(3x-11y)(4x+3y)-2(3x-11y)$$
$$=\underline{(3x-11y)(4x+3y-2)}.$$

$$\therefore\ \text{H.C.F.}=\underline{3x-11y}.$$

5. H. L. K.—Solve:—

$$x^2+2x+5=\frac{300}{x^2+2x}.\quad (\textit{Scholarship}, 1878.)$$

$$x^2+2x+5=\frac{300}{x^2+2x}$$
$$(x^2+2x)^2+5(x^2+2x)=300$$
$$(x^2+2x)^2+5(x^2+2x)+(\tfrac{5}{2})^2=300+\tfrac{25}{4}$$
$$=\tfrac{1225}{4}$$
$$x^2+2x+\tfrac{5}{2}=\pm\tfrac{35}{2}$$
$$x^2+2x=\pm\tfrac{35}{2}-\tfrac{5}{2}$$
$$=15,\text{ or }-20$$
$$x^2+2x+1=16,\text{ or }-19$$
$$x+1=\pm4.\ \text{(As we cannot take the square root of a negative quantity.)}$$
$$\therefore\ \underline{x=3,\text{ or }-5}.$$

Note—It is possible, but he must do splendid papers in the other subjects.

6. A. W., LEEDS.—The difference of the squares of two numbers exceeds the square of their difference by 26 times their difference, and the square of the less exceeds 7 times the greater by 8. Find the difference. (*College of Preceptors*, December, 1884.)

Let x and y represent the two numbers;

Then, (1) $(x^2-y^2)-(x-y)^2=26(x-y)$
(2) $y^2-7x=8$

(1) $(x+y)(x-y)-(x-y)^2=26(x-y)$

Dividing by $(x-y)$ $(x+y)-(x-y)=26$

$$2y=26$$
$$\therefore\ \underline{y=13}.$$

(2) $y^2-7x=8$
$169-8=7x$
$7x=161$
$\therefore\ \underline{x=23}.$

$\therefore$ Difference of the two numbers $=\underline{10}$. Ans.

7. PUZZLED.—What is the price of eggs a dozen, if when they are reduced a penny, I can buy two more for a shilling?

Let x = cost per doz. in pence,

Then, $\frac{12}{x}\times12$ or $\frac{144}{x}$ = No. obtained for a shilling;

$$\therefore\ \frac{144}{x-1}-\frac{144}{x}=2,$$
$$144x-144x+144=2x(x-1)$$
$$72=x^2-x$$
$$x^2-x+(\tfrac{1}{2})^2=72+\tfrac{1}{4}$$
$$=\tfrac{289}{4}$$
$$x-\tfrac{1}{2}=\pm\tfrac{17}{2}$$
$$x=\pm\tfrac{17}{2}+\tfrac{1}{2}$$
$$\therefore\ \underline{x=9,\text{ or }-8}.$$

$\therefore$ Price of eggs $=$ 9d. per dozen. Ans.

8. NOT-FOR-JOE.—Solve:—

$$\frac{x+\sqrt{x^2-1}}{x-\sqrt{x^2-1}}-\frac{x-\sqrt{x^2-1}}{x+\sqrt{x^2-1}}=8\sqrt{x^2-1}.\quad (\textit{Todhunter.})$$

$$\frac{x+\sqrt{x^2-1}}{x-\sqrt{x^2-1}}-\frac{x-\sqrt{x^2-1}}{x+\sqrt{x^2-1}}=8\sqrt{x^2-1}$$

$$\frac{(x+\sqrt{x^2-1})^2-(x-\sqrt{x^2-1})^2}{(x-\sqrt{x^2-1})(x+\sqrt{x^2-1})}=8\sqrt{x^2-1}$$

$$\frac{x^2+2x\sqrt{x^2-1}+x^2-1-(x^2-2x\sqrt{x^2-1}+x^2-1}{x^2-(x^2-1)}$$
$$=8\sqrt{x^2-1}$$
$$4x\sqrt{x^2-1}=8\sqrt{x^2-1}$$
$$4x=8$$
$$\therefore\ \underline{x=2}.$$

As we divided by $\sqrt{x^2-1}$, we can put $\sqrt{x^2-1}=0$

$$x^2=1$$
$$\therefore\ \underline{x=\pm1}.$$

$$\therefore\ \underline{x=2,\text{ or}\pm1}.$$

General.

1. CUPID.—The extract is a humorous way of describing the unexpected discharge of cannon by Satan and his host against Michael and the angels under the figure of offering terms of peace. The contents of the cannon (iron balls, powder, etc.) are spoken of as 'terms of weight, of hard contents;' the discharge as 'urging the terms home with force' (another way of saying strong arguments were used to attain the desired end); the effect as causing 'amusement' or stumbling (such as might be caused by offering unexpected terms in a treaty for peace). Belial goes on further to say—still keeping up the humorous vein—that a person to receive such arguments properly must understand them well from head to foot (that is, have power to stand well on his feet); as they had not been understood, an opportunity had been given for them to see which had been overthrown by the discharge. Is the above what you want?

2. DESIROUS.—You will find the solution of your query in our issue for August, 1884. See No. 3 query in algebra.

3. SIXMILEBRIDGE.—(1) The solution of your query appeared in our issue for July, 1884. (2) The questions appeared in *The Schoolmaster*.

4. WILDHEN.—Your first query was solved in our issue for January, 1883, and February, 1884; and the second in our issue for February, 1882.

5. THE SCREAMER.—As you state, the question is one such as Theodore Hook might have concocted.

6. BLUE BEARD.—The ball would be carried forward with the air, if it were possible to remain an hour above the earth.

7. STERLINI OPPIDUM.—You will find the solution of your query in our issue for April, 1882.

8. POM-POM.—Your query states that, although half the window was removed, it was still the same size. As this is absurd, please repeat your question *correctly*.

9. BILL AND WILLIE.—*Burchett's* 'Linear Perspective,' price 5s. (Collins).

10. B. O. T.—Write to Messrs. G. Gill and Sons, who publish a good one; also to the Home and Colonial.

11. MEMORY AND SUCCESS.—We will make full inquiries, and answer in our next issue.

12. S. NOSE.—The results of the science examinations may not be published before you sit in July, but they will be issued before the scholarship list is out, and you will get credit if you pass successfully.

13. POM-POM.—Small, 70; text, 65; large, 80.

14. BAPTISTA.—We cannot say. You would obtain full information by writing to the secretary of any of the institutions you name.

15. NO NAME.—Large hand, 70; small hand, 80.

16. HAMLET.—We should think that no marks would be allowed, as the course for the two examinations is nearly the same.

17. EXCELSIOR.—We should recommend for Conics, *Smith's* 'Conics,' published by Macmillan; *Todhunter's* and *Besant's* are very good. Try *Williamson's* 'Differential Calculus,' and *Garnett's* 'Dynamics.' You may add *Todhunter's* 'Mechanics for Beginners.'

18. R. D. T.—Hachette and Co. publish both the 'Histoire de Bayart' and Racine's 'Athalie.' There is a translation of 'Athalie' in Bohn's series. Questions from both these are set in the 2nd year's papers; these questions, indeed, form the easiest part of the examination paper.

19. J. S. P.—Have you seen the *Civil Service Gazette?* Perhaps there are no appointments to be filled up.

20. TUTUS DUM RECTUS.—Consult, say, *Smith's* 'Latin Grammar,' articles 102 and 518; also *Arnold's* 'Latin Prose Composition,' page 138 and page 54. For sequence of tenses see *Smith's* 'Grammar,' article 423.

21. ANXIOUS.—Large hand, 65; small hand, 60. The writing in both cases is very poor indeed. The best thing to do would be to get a good set of copies and imitate them; only a few of the letters are properly formed. (1) Drawing, yes; (2) Latin, no; (3) Yes.

22. M. D. F.—(1) Tomb of Mausolus; (2) Statue of Jupiter at Elis; (3) Colossus at Rhodes; (4) Hanging Gardens at Babylon; (5) Walls of Babylon; (6) Pyramids of Egypt.

23. W. B.—75.

24. ASSISTANT.—Yes, decidedly; any ex-P. T. ought to be ready for it without preparation.

25. FERGUS STEWART.—You have not qualified for an assistant. You must complete your P. T. course or pass the Q. S. examination.

26. MAB.—Large hand, 70—edges ragged; small hand, 75—irregular and rough.

27. GWYLYM PYWELL.—A, 75; B, 80. Large hand unsatisfactory in both; lacking in firmness, curves irregular in A.

28. VERITAS.—You will find, perhaps, all you want in *Sonnenschein's* 'Code Reform,' 1882, Teachers' Edition. For the latest information respecting French education write to Hachette and Co. for the recent regulations for primary schools.

29. T. H. C. SHAW.—By the conditions of the question

1 cm. at 0° C. becomes 1·00086 cm. at 100° C.
Also 1 cm. ,, 100° C. ,, 1·00092 cm. ,, 200° C.
∴ 1 cm. ,, 0° C. ,, 1·00086 × 1·00092
= 1·00178 at 200° C.
∴ 1·00178 cm. at 200° C. becomes 1·00092 at 100° C.
∴ 1 cm. at 200° C. becomes $\frac{1\cdot00092}{1\cdot00178}$ at 100° C.
∴ 12 cm. ,, ,, ,, $\frac{12}{1} \times \frac{1\cdot00092}{1\cdot00178} = 11\cdot98892$ cm.
or ·1198892 m.

Similarly 12 cm. at 200° C. become $\frac{12}{1\cdot00178}$ at 0° C.
= 11·97868 cm. = ·1197868 m.

—o—

'Practical Teacher' Prize Story.

A TALE OF TWO SCHOOLS.

BY NOVICE.

(*Founded on Dr. Carpenter's 'Health at School.'*)

CHAPTER I.—MR. STAFFORD.

'WELL, my dear, thank goodness another day's drudgery has been got through. I really cannot think how we are to do even tolerably well at the examination, and it takes place in a month's time. My head is aching as though it would split, and I feel as tired as if I had been on the treadmill for the last twenty-four hours!'

'Never mind, Harry; sit down and have a good cup of tea, and then you will feel better.'

It was half-past four, on a wretched November day, and Mr. Stafford, the first speaker, had just come out of the school to the school-house adjoining, where his wife had been waiting for him, and was now anxiously watching his sallow, worn face. He was a man of about twenty-eight or thirty years of age, and he had left a school in the Midlands, to accept an appointment in a small town in a rural district in one of the southern counties. When at college, he had been rather distinguished as a gymnast. In cricket, football, and other athletic sports he had held a leading position. This, combined with a most affable, pleasant manner had gained for him the friendship of many of his fellow-students—in some cases a friendship that was to last for life. He had been unanimously elected captain of the cricket club, and had helped to gain many a victory over neighbouring colleges.

After leaving college, at the expiration of the usual two years, he had held, with great credit to himself, and consequent benefit to his pupils, a boys' school, as before stated, in the Midlands.

He had been now nearly a year in his present school, and, though surrounded on all sides by a pleasant, even delightful, country, and living in a town remarkable for the health of itsinhabitants—as shown by the low death-rate, the great age of many of its present inhabitants, and of their predecessors, as recorded on many a weather-worn stone in the neighbouring cemetery—yet for some months past his health had been gradually getting more and more unsatisfactory.

He was a man who was not afraid of going through a hard day's work; indeed, he was never happy unless his mind and body were equally well employed. Lately, however, his work had become a burden. Teaching, for which he had always had an intense liking, had lost its pleasure. He looked forward with longing for a quiet evening with his wife, knowing that he would not be likely to be disturbed by visitors; as, being a complete stranger to the townspeople on his arrival, and they being of an exceedingly close and unsociable nature, as a whole, had neither troubled him by visiting him, or by giving him any invitation. This coldness had at first depressed him; but, finding this was their usual manner towards strangers, this feeling had passed away, and he had spent most of his leisure hours in increasing his stock of knowledge and accompanying Mrs. Stafford and their little daughter in their quiet evening walks.

There was one in the town who had welcomed him, and who was frequently to be seen with the trio in the pleasant summer evenings. This was Mr. Henton, master of a school at the other end of the small town, who had been a fellow-student at college. While there, the two had found their dispositions were very different; but there was something which drew them together, and, though surrounded by many friends, they had become so closely attached to one another as to have received the name of the 'Inseparables.'

Mr. Henton called in during the evening, and, remarking that Mr. Stafford seemed to be very unwell, did not stay long; telling his friend as he left, that he hoped his school-work was not worrying him, notwithstanding the well-known desire of his committee, a body of ill-informed men, that he should pass a higher percentage than the (as they considered it rival) school. This they considered to be the only test of the efficiency of a school.

CHAPTER II.—MR. STAFFORD'S SCHOOL.

WE will accompany Mr. Stafford on the following morning to his school. We may there, perhaps, find the cause of this ill-health. Just stepping across the playground, which is covered by gravel plentifully sprinkled with stones, which add to the fortune of the cobblers of the town, but seriously subtract from the pockets of the parents of the children, we enter a building large enough to easily accommodate the number of children who are soon assembled.

Without interfering with the work, which is rather noisy, notwithstanding Mr. Stafford's well-known reputation for discipline, but which is readily explained by the fact that there are no class-rooms, we first notice the windows, which, inside and out, are coated with dirt, which appears never to have been disturbed since the school was first opened. This, in itself, may help to

spread disease, as it is possible for infectious germs to be deposited from the breath on the glass.

The windows, too, are only carried up little more than half the height of the wall, and there is no outlet of any kind in the roof, or at the top of the wall, to allow the foul air to escape.

Some attempt has been made to admit pure air into the room, but how? We see rows of holes bored in the floor, in regular lines across the school, and some iron gratings.

We should like to know what is the nature of the soil on which the school stands, as that renders the air impure if it contains organic matter; for already the school begins to smell close and stuffy, and these holes have evidently not allowed sufficient pure air to enter.

But who is this gentleman now coming in? It is Mr. Sloman, the secretary. He evidently seems to think it necessary to assume a walk in harmony with his name, for he moves with an elephantine gait up to the desk.

'Good morning,' he drawls out, 'how is your attendance this morning?'

'Oh, very low indeed, Mr. Sloman. We have no less than twenty children absent through illness. They are mostly suffering from slight colds and other not very serious ailments; but one boy, in the Fourth Standard, the best boy in his class, is confined to his bed with typhoid fever.'

'De—ar me! I really do not understand how it is that Mr. Henton has scarcely one child ill, and his attendance is better now than it has been all the year.'

'Mr. Henton has the good fortune to have a committee, most of the members of which have conscientiously studied the health of their children and also of their teachers.'

'Oh, thank you, Mr. Stafford. Good morning.'

'He doesn't relish that last little speech, I suppose,' soliloquises our formerly affable master, but who is growing more taciturn, and, we must say, more unamiable, every day.

When play-time is over, during which the school has been ventilated as much as possible, by opening all the windows, the scholars once more get to work, a little refreshed by their play; some, however, looking as cold as charity, which, now-a-days, has a very chilly reputation. These boys, like their master, seem to be losing their energy; even a game at leap-frog is too much for them, and they come and settle down in a very lackadaisical style to find out what seems to them an awfully difficult problem in Rule of Three, or some other equally delightful rule.

In the afternoon, Mr. Stafford has two notes handed to him. What are their contents? They seem to make his pale face still more pale. He reads in both that dreadful word—typhoid fever. Three boys away, laid up with the same terrible disease. What can be the reason?

The School Attendance Committee officer comes in soon after—a man, who did his duty, on the whole, tolerably well. He, of course, is told of the state of affairs.

'I don't know how it is, Mr. Stafford, but your school has a most peculiar smell in it whenever I come in; but, however close the weather may be, Mr. Henton's school is always quite free from anything of the kind, and the children always seem more bright and cheerful.'

Mr. Stubbs, the officer, communicated with his committee on the following Friday, with what result we shall see.

CHAPTER III.—MR. HENTON'S SCHOOL.

MR. HENTON had been appointed to his present school about four years previously. It was a new one, and its promoters, while working in as economical a manner as possible, had endeavoured to build a school which should be perfectly healthy, being well-ventilated, drained, situated in a healthy position, and on a site composed of material which would not deteriorate the air in the school-rooms.

Mr. Merriman was the secretary, a gentleman of most engaging manners, combined with thorough-going business habits. He had entered heart and soul into the scheme at first, and had ever since aided the master to the utmost of his ability. This gentleman, well-knowing the importance of the subject, had made school hygiene his study; and, not content with merely reading books, had sought the practical knowledge to be derived from conversing with such men as Dr. Woodruff, the sanitary inspector, and by seeing models showing different plans of ventilation, warming, and drainage.

At the outset, the committee having raised funds sufficient to commence operations, with promises of further donations and subscriptions which justified them in sparing nothing to make it a model school, proceeded to select a proper site.

They had one or two very tempting offers. In fact, one, situated at the foot of a hill just outside the town, could be had for a mere song; the position, too, being remarkably pleasant, and, apparently very healthy. They, however, refused these, the latter because of its dampness, and the fluctuating sub-water; one or two more because they had been holes filled up with any sort of rubbish the townspeople liked to throw in.

At last they decided upon a site on gravel. Trial holes were sunk, and it was ascertained that the ground-water remained tolerably level; the difference between the rise and fall being such that it was not thought necessary to provide special drainage for it. The top soil was dug out for about six feet, and a layer of chalk and concrete was put down. The floor was made level with the surrounding land, but the walls were carried straight up from the lower level, leaving a chamber below the school for coals, etc., and a dry area all round.

The spouting was amply sufficient to carry off any amount of rain, thus preventing the walls from becoming soaked by an overflow on some unusually wet day. The rain-water was carried off at once by proper watercourses into the streets of the town.

We have thus recounted its earliest history, and now will look at the building on the outside before we enter. There is evidence of thoroughness in its construction. No rubbish has been allowed a place in any part. It has a spacious playground, which, as it is on the outskirts of the town, it has been found possible to turf, and to keep in very fair condition, notwithstanding the immense amount of wear Mr. Henton's children subjected it to.

The offices have been placed at some little distance from the main building, being connected by a passage, roofed with galvanised iron, but otherwise being quite open to the atmosphere. Great care has been taken that the connection of the offices with the main sewer should be carried obliquely, and with sufficient fall, under the playground wall, the piping being laid on a firm concrete flooring.

It is necessary to mention these matters, from the important influence they have on the scholars' health.

It being November at the time we visit the school, we do not see many children using the three or four tin mugs which are chained to the walls of the school-lobby, where a supply of beautiful, clear water, rendered so from passing through the chalky soil, has been laid on. We can see, however, that Mr. Henton has inculcated some amount of cleanliness and tidiness in his boys, for there is no appearance of damp on the stone floor of the lobby, as is seen in some places.

We will now pass through the lobby, when we find ourselves at once in the large room, the floor of which is well-oiled, and has no holes in it. At one end there is a useful gallery, at the side of which there is a passage leading to one of the two class-rooms. In each of the three rooms, a space has been boarded off, to form a convenient place for caps, coats, etc. This we cannot help contrasting with the school we found somewhat under a cloud at the other end of the town, where the caps hung in rows along the walls of the room, exposed to view, giving it a very untidy appearance.

This is not the only thing that contrasts favourably

with Mr. Stafford's school building. The windows are carried right up to the ceiling, and proper provision is made to admit pure air from the outside area, it being warmed by Bunsen burners beneath the floor, which derive their necessary air from the air of the room, the warm pure air passing up the tube into the building, without coming into contact with the gas.

When the outside air is not too cold, the windows are thrown open a little way at the top, the aperture being covered with perforated zinc.

When, however, the air falls twenty degrees below the inside air, as shown by the thermometer, then the windows are kept closed, and the whole work of removing the warm foul air has to be done by some Boyle's ventilators fixed in the ceiling.

With this system in operation, Mr. Henton has not to complain of a close atmosphere, rendering teaching a most irksome occupation; but his work is carried on under such circumstances as to be a pleasure.

We need not weary the reader with a further description of this school, so admirably adapted to the purpose for which its promoters intended it; but must return to Mr. Stafford.

CHAPTER IV.—MR. STAFFORD'S SCHOOL IS CLOSED.

CHRISTMAS has passed away—not a very pleasant one to the Staffords, for more than one reason. His health is getting worse, and he has received a very disheartening report, and has had some exceedingly annoying observations made to him thereon by his committee. Of course, they, who think about the school once a year, when the Government grant is due, are exasperated to find that Mr. Stafford's percentage is very considerably below what they would have liked. They have come to the conclusion that Mr. Stafford has no genius for teaching, not taking into account the fact that none of them have any genius for managing.

There were plenty of people in the town, which, by the way, was full of worshippers of the golden calf, who, notwithstanding, would have supported the school, if properly solicited; but Mr. Sloman, who was expected to perform that duty, never once thought of such a thing as seeking for new subscribers. It is doubtful if he ever had any thoughts at all, as they are known to travel faster than the electric fluid, and everything in connection with Mr. Sloman was emphatically slow.

Mr. Stafford's pupils who had been stricken with that dreadful fever had been for some weeks lying in such a state that Dr. Woodruff could not give the parents the slightest hope of recovery. One little fellow, the first who had been ill—a bright eyed, merry, light-hearted boy, who was the favourite and hero of the boys in his class—had passed away, almost his last thoughts being for his playfellows and his schoolmaster. The other two, however, had passed the crisis, and were now slowly mending. It would be weeks before they could again join in the games of their schoolfellows, and then they would do so under very different circumstances. But we must not anticipate.

In the meantime, what has been the course pursued by the sanitary authorities? For some time, as usual with many other people in similar positions, they did absolutely nothing.

At last, Mr. Stafford has been laid aside, and a student has been sent 'on supply.' The number of children absent through illness has increased, and though no one else has been attacked by fever, yet it is felt that something must be done. Dr. Woodruff is sent to make a thorough inspection of the building, and without producing his report verbatim, we gather from it the following details:—

In the first place, the walls are very damp. The spouting has been left to take care of itself, and has obstinately fallen out of repair. The warming has been attempted with open fireplaces, with complete failure, except in regard to those children who happened to be in close proximity to the fire, and they were nearly roasted.

These defects were not serious enough to have caused all this ill-health. What further can there be to account for it? We read that the sewerage pipes were next examined, and that they were found to have been laid down under a part of the school-building—Mr. Sloman said because it had saved the committee five pounds, not thinking how much they had lost through it since; but, of course, as we before stated, Mr. Sloman could not think. Then, following the course of the pipes, it was found that the school had been built on a made foundation, this having been one of those depressions, which, in some previous time in the town's history had been filled in as the people had liked, by all sorts of refuse, organic matter being abundantly represented. This of itself was enough to seriously contaminate the air of the school, even supposing that the ground-water maintained a constant level. After careful examination, however, the sanitary inspector reports that he found it varied very considerably, and he shows in his report, that, as the water rose in the sub-soil, so it displaced the stagnant impure air upwards, sending it to *ventilate* the school through the holes so cleverly placed in the flooring. He further states that this sub-soil air contains from four to eight per cent. of carbonic acid, while atmospheric air contains only four parts in 10,000.

While reading this, we could not help thinking that it surely was no wonder that Mr. Stubbs, the attendance officer, had remarked the stuffiness and peculiar smell of the room. The only wonder is that more illness was not the result. This wonderment was increased as we read, farther on, the following words:—

'Still pursuing the course taken by the drain-pipes beneath the school floor, we came to a place where the earth had given way. This caused the earthenware pipes to break, and, in consequence, there had been an overflow of sewage, which had spread itself for some distance in the refuse matter—which already vitiated the school air—thus producing those poisonous germs which had taken root, causing the attacks of typhoid fever.'

Here, then, was the reason for the wretched state of health of Mr. Stafford and the boys under his charge. The miserable excuse of Mr. Sloman that the committee had saved a paltry five pounds, which would have caused him a little extra exertion in collecting, had ruined the school, for the Government inspector at once condemned the whole thing, buildings and site, and the school had to be closed at once.

CHAPTER V.—A HALF-HOLIDAY.

ONE fine Wednesday afternoon, at the beginning of March, a number of boys might be seen standing at the end of the High Street, watching two others, rather heavily-laden with school-bags. One of these is Fred Harrison, Mr. Henton's very promising pupil-teacher. The younger one, Tom Roberts, is a rather small, but wiry-looking little fellow, in the Fourth Standard. These are the hares, and they have just started off at a trot, as they wish to make the most of their ten minutes 'law,' but, at the same time, to reserve their wind and strength for a possibly close finish.

These two boys look the very picture of health and enjoyment. It is at once seen that Harrison has a kind master—one who can understand that a boy is not made of such tough material as to be able to be always on the grind, either in study or at work in the school. At the same time, he is not a man to allow idleness. In Harrison's case, however, there is no need for compulsion, as he is one of the most willing and persevering of boys, who has won his master's affection, and who intends to gain all the credit possible, both for himself and Mr. Henton, by working well, both at home and at school.

As there are several boys of Roberts' age to run as hounds, it is considered only fair that one of the hares should always be a small boy.

Mr. Henton is standing with the hounds, watch in

hand, ready to start them. He gives his final instructions as to their acting quite fairly in always following the scent, and to the younger ones not to over-exert themselves; and then, just as the ten minutes is up, off they go at a good round pace. This is rather too fast just at first, for they will have a stiff run across country, Harrison knowing well every field and hedgerow for miles round. They soon settle down into a steady trot, the whipper-in keeping the little ones and the stragglers up to their work. After half-an-hour's good run, with a strong scent all the way, they find themselves at fault. The fact is, the hares are rather too artful for them, and they do not know which direction to take.

Harry Bright, the head boy of the school, who is looked up to by the others, and whom they call the 'Master of the Henton Harriers,' gives the word, and they scatter in all directions to discover the lost scent. After another five minutes—a great gain to the hares—a bugle is blown, as a signal that the track is once more found. Away they dash in pursuit, but they never come up with the hares, who come in quite seven minutes ahead of the first of the hounds.

The boys, as they assemble once more in the playground, before going to their homes, look considerably dirtier than when they started; but, with their faces flushed with the excitement and exertion, they appear to be none the worse for their afternoon's run.

Mr. Henton, after seeing the boys start, at once turns his steps along the High Street, to the apartments occupied by Mr. Stafford since the school had been condemned. He is still confined to his room, and his face looks very thin and pale. His eye, once so bright and cheerful, is dull and heavy; and altogether he does not appear to be the same man Mr. Henton remembers some few years ago.

However, he is somewhat roused from his usual depression on seeing his old friend enter, and when he leaves Mr. Henton has the pleasure of knowing that his visit has been the means of reviving some of the old spirit.

They, of course, have gone back, in their conversation, to the sports of their college days, when they had entered, heart and soul, into the pleasures of cricket, boating, and football; and many an incident is recalled in which one or the other had either contributed a good score to their side at cricket, or kicked a goal just before time was called, thus winning an exciting football match.

These memories are always full of interest, and came to Mr. Stafford in his weak state as a gleam of bright sunshine, breaking through the dark clouds which, nearly ever since he had entered this town, had seemed to overshadow his life.

He had resolved to go to his parents, who lived in that most charming and delightful of English counties—Devonshire. There, in the pretty little town of Dawlish, situated on the south coast, within easy distance of Exeter, he hoped, with a few weeks' entire rest, to recover his usual health.

The coast all along this part of Devon is remarkably bold and picturesque, though scarcely so grand as that in the north. The climate is very mild, and at this early time of the year he would be able to wander along the beach, or roam over the cliffs in the direction of Teignmouth, without being exposed to the full severity of those bitter winds so keenly felt on the east coast. Or, he might extend his walks inland, where he would recall those beautiful Devonshire lanes, with the tall hedges meeting overhead, in which he had often spent his summer evenings, with a fair companion leaning on his arm, who is already known to the reader as Mrs. Stafford. The hills, too, he would, as his strength returned, be able to climb, and gaze over a most lovely country.

With what pleasure did he anticipate this change! And before Mr. Henton had left him, this bright afternoon, he had told him of his expected removal, and had expanded into somewhat of his old vivacity of manner, as he spoke of his boyhood's home.

Three weeks after this, he had left the town, full of unpleasant memories to him, as he thought, never to return to it.

After leaving, Mr. Henton had taken a good, smart, six miles' walk, before settling down to his usual evening study.

Thus, this half-holiday had been a most pleasant one to the two masters, as well as to the hares and hounds.

CHAPTER VI.—THE SCHOOL BOARD.

THE whole town was now in a state of commotion, for there was to be a large public meeting, called by the Mayor, to consider whether they should select a School Board. There had always been a strong party opposed to this, especially since Mr. Henton's school was opened; but the opinion was expressed in every barber's shop and public-house that this party must now give in.

The evening came, and it seemed as though the whole town was coming to the rather handsome Town Hall. We will not stop to analyse all the speeches for and against, but come at once to the result—namely, that as there had not been sufficient funds derived from voluntary sources to keep the lately condemned school in a proper condition, and as there was now not sufficient school accommodation, the only course was to establish a Board.

An election soon after took place, and the Board set to work at once to erect a new building. No time was wasted over discussing an imaginary religious difficulty, but all their energies were directed to what to them was *the* most important subject—namely, how to build a school in which the children could be taught without incurring the dangers so lately experienced in the wretched structure in which Mr. Stafford had taught.

A site was chosen not very far from the first, and as the ground-water was not quite stationary in level, proper means were taken to drain it. All the top soil was taken out, and on a layer of chalk asphalte was placed. The school was built in much the same style as Mr. Henton's, every care being taken to have it perfectly dry, well-ventilated, and properly warmed. The water supply was well attended to, and kept away from the offices. A lavatory was added; and as more accommodation was needed in the town for girls, the school was built with two storeys, the top one being for them. In nearly every other respect the school was built on the same sound principles adopted by the committee of the voluntary school.

About a month before the new building was ready to open, a Board meeting was called to consider the applications from teachers received by the clerk in reply to his advertisements in the *Schoolmaster* for a master and mistress. Among the number was one from Mr. Stafford, who by this time was completely restored to health. He had found all the benefits anticipated in his conversation with Mr. Henton.

After some discussion, in which one of the late committee tried to say something against his appointment, he was elected, the only dissentient being the said gentleman. The mistress was a Miss Alice Danford, from a London school.

CHAPTER VII.—THE SCHOOL TREAT.

WE must now pass over a period of about two years. It is a lovely day in July. There is not a cloud in the bright blue sky, the air is filled with the hum of insects, and all nature seems to have put on its most enticing aspect. There is a slight breeze from the north-east, just sufficient to temper the heat of the sun.

The scenery all round is charming. The hills seem to melt away in the distance, where earth and sky merge into one. The valley is well-wooded, being occupied by gentlemen's parks.

In one of these we see great numbers of children wandering about, some down by the trout stream, others up amongst the trees. Here are a number of girls collecting wild flowers; there are some skipping and running; and a gentleman is just fixing some stout rope to a strong limb of one of the splendid chestnuts so abundant just here, for swinging.

Passing farther into the park, we come to a wide, open space, nicely rolled and mowed, in which we see there is something very important going on. Getting closer, we find that it is a cricket match between the Board school and Mr. Henton's school. See how eager the onlookers are! The fact is, there is a friendly, but keen, rivalry existing between the two schools, and this match has been looked forward to for some weeks past with the most intense anxiety. We seem to remember that stalwart man who is standing umpire at the farther wicket, and at once recognise our old friend, Mr. Stafford. Harrison, who is going to college, if successful, next Christmas, is umpire at this end.

Schoolboy cricket is not generally interesting to those who thoroughly understand the game, except that they are glad to see boys engaged in such manly, healthy exercise. As is evident in the present game, it is one of great enjoyment to the youngsters, both those who are playing and those who are looking on from all parts of the field, reclining in every imaginable attitude.

The Voluntary boys at present seem to be having the best of it, for they are hitting the bowling all over the field. At last, they are all out for 80—a very decent score. The Board boys—Mr. Stafford's, it will be remembered—do not look much like those we found him teaching when we first became acquainted with him. They do not keep us long waiting, like a good many of their elders are fond of doing, between the innings, but send out their two first *men* to the wickets.

They start badly, for both are out with the score at 2. Altogether the eleven compile 52 runs between them. In Mr. Henton's boys' next venture they only put together 36 runs, leaving the Board boys 65 runs to get to win. They, however, failed to do this, the last wicket falling with the score at 51, leaving the Voluntary boys winners by 13 runs.

By the time this is finished four o'clock has arrived, and the children are gathering together from all parts of the park, which has been very kindly thrown open to both schools by the owner, the Chairman of the School Board, a gentleman who takes the greatest interest in education, and who likes to see children enjoy themselves.

He is now conversing with Mr. Henton and Miss Danford; and Mr. Stafford, released from his important duties in the cricket field, has just joined the group. Mr. Hawthorne is a gentleman in the prime of life, whose face shows the kindliness of his heart. He is one of those genial men who can talk to men in a subordinate position in the most friendly manner, without losing any of the dignity some *gentlemen* think must be guarded by an abrupt, haughty demeanour.

When the children are assembled, tea is served out to them, after which Mr. Hawthorne and other friends of both schools offer rewards for racing, jumping, etc. These are keenly competed for by boys and girls. This completes the day's amusements.

CHAPTER VIII.—FURTHER IMPROVEMENTS.

THE School Board in this little town are at all events to be congratulated on the health of the children, as compared with the state we found it in at the commencement of our story. There is no longer that listlessness and languor observable in the playground; all seem to enjoy themselves to the utmost. But, remembering the maxim that "cleanliness is next to godliness," they have done everything in their power to encourage bathing.

A part of the river has been fenced off, and a proper person has been appointed to take charge of the place, and to teach the boys that most necessary accomplishment, swimming. The children are, in most cases, only too willing to learn. Of course, there are some parents who object to this, as is always the case with anything beneficial. They do not, having never learnt themselves, see the use of it, or else they are afraid of their precious treasures taking cold.

Besides the benefit to be derived from the practice of swimming, what is there to compare with the feelings of a man who has been able to save a fellow creature from drowning? Then, as to the benefit derived by the children—it helps to keep open the pores of the skin, thus allowing the function of perspiration to be properly carried on. A child who does not, by washing, remove the worn-out cells of the skin, is more likely to fall under the attack of infectious disease. One who is not afraid of the sudden plunge on a summer morning into the cool stream is less likely to catch cold or fever from a sudden drenching in a storm, or an immersion from the capsizing of a boat.

(*To be continued.*)

—o—

Matriculation Hints.

BY HENRY A. REATCHLOUS, M.A. (LOND.), B.Sc.,
Westminster Training College.

THE use of the hygrometer seems to be included in the course in Natural Philosophy. There is always a certain amount of aqueous vapour present in the atmosphere. We can determine how many grams of water there are in a given number of litres of air, by drawing the moist air through drying tubes by means of an aspirator, and weighing the tubes after. The difference of weight would be the weight of water present; the quantity of water which passes through the aspirator measures the air which has been dried.

But it is not so much the absolute quantity of moisture present, as the ratio of this to the quantity which would saturate the air at the given temperature, that we have to find. This ratio is called the hygrometric state of the air. To determine it, we have to use a hygrometer, and consult a table of vapour pressures. We will give directions how to make a Regnault's hygrometer, how to use it, and then how to find the hygrometric state of the air. Order a thin boiling-tube to have a copper cap, about an inch long, fitted on the end of it and silvered. If the student is accustomed to silvering he can do that himself. Now fit the boiling-tube with a cork with three holes. Into one insert a thin thermometer; into the two others pieces of glass tubing, one dipping nearly to the bottom, the other just below the cork. Connect the long tube with an aspirator. This can be made out of a Winchester or a wash bottle. But an earthenware jar, in the shape of a filter, does much better, a small tap being inserted at the bottom. Fix the hygrometer in a clip-stand, pour some ether into the tube, and fill the aspirator with water. Take the temperature of the room; say it is 15°C. Now turn the tap, and as the air bubbles through the ether, its temperature gradually falls, till it reaches a point at which the air immediately surrounding it is completely saturated. This is the dew-point. As soon as the silver looks dull, the temperature is taken. It is well to take it again as soon as it appears bright again, and then call the average of these the dew-point.

Having found the dew-point, we get the hygrometric state thus:—Turn to a table of vapour pressures; there is one at the end of Stewart's 'Heat.' Look at the number opposite 15° C., or 60° F.—it is .5178.

Suppose the dew-point is 10° C., or 50 F., the number opposite this is .3607.

And the hygrometric state is the ratio $\frac{3607}{5178} = .69$.

If we use a Daniell's or a Dine's hygrometer, the method is the same; first find the dew-point, and then refer to the vapour pressures corresponding to the

actual temperature of the air and that of the dew-point, and the ratio of the second to the first is the hygrometric state.

Gases and liquids are both fluids. Gases are distinguishable by compressibility and by their tendency to expand indefinitely. Boyle's law and its applications should be studied. If V be the volume, and P the pressure, of a given mass of a gas, the product VP will be a constant quantity, every change in V involving a corresponding change in P. Instruments for measuring the pressure of gases or vapours are called manometers. A U-tube, with a little mercury in it, illustrates the principle of one of them; one end of it can be attached to the gas supply, and the difference of level observed. Suppose the barometer stands at 76 cm. This corresponds to 1033 gms. per sq. cm.; a difference of 2 cm. would, therefore, imply a pressure of $\frac{1033 \times 2}{76} = 27$ gms. per sq. cm.

The fact that air has weight can be easily demonstrated, even with an ordinary balance. Expel the air from a flask by boiling a little water in it; when the steam is escaping vigorously, close up the end. Let it cool, and then counterpoise; now allow air to enter. The increased weight of the flask will be at once apparent. If there is an air-pump at hand, a globe can be weighed before and after exhaustion.

Much simpler methods of finding the weights of a litre of air and other gases than have hitherto been thought practicable are to be found in the little work by Dr. Ramsey, called 'Experimental Proofs of Chemical Theory.'

What is called the Torricellian experiment should be thoroughly understood. The height of the mercurial column indicates the pressure of the atmosphere at the place of the experiment. If it is 76 cm., the weight on a sq. cm. is $76 \times 13{\cdot}6 = 1033$ gms. This is equivalent to $1033 \times 981 = 1{,}013{,}667$ dynes per sq. cm. Notice that the atmospheric pressure in the case above, 1,013,667 dynes per sq. cm., divided by the specific gravity of mercury and the force of gravity at the spot, gives us the height of the mercurial column $\frac{1013667}{13{\cdot}6 \times 981} = 76$. We could find the height of a column of any other liquid by substituting its specific gravity for 13·6; thus, for water it would be $76 \times 13{\cdot}6 = 1033{\cdot}6$ cm. = nearly 33 feet.

If a little water be allowed to enter the tube with the mercury, some of it will be vapour in the upper part of the tube and depressed column of mercury. The exact amount of the vapour pressure will depend upon the temperature, and can be found, by reference to a table, in grams per sq. cm. This pressure remains constant so long as the temperature does not alter, whether the tube be raised or lowered, provided there is always a little water not vaporised.

If, instead of a small quantity of a liquid, some air or any other gas should enter the tube, there will be a depression of the mercury, but the amount of depression will vary with the space occupied by the gas. Boyle's law applies to gases, but not to saturated vapours.

Archimedes' principle applies to gases as well as liquids. It is owing to this that balloons rise. They will ascend so long as their weight is less than that of the air displaced by them. The syllabus specially names the barometer, syphon, common pump, forcing-pump, and air-pump; these are all fully described in the manuals in common use. The main thing in regard to the atmospheric pressure is to know how to estimate it and express it. The old way, stating it in lbs. on the in sq. inch, should be discarded. For scientific if not for general purposes, the metric system is sure to be ultimately adopted, perhaps before very long. And pressures should be expressed in dynes per sq. cm., in preference to grams; because grams, like lbs., do not bring out the fact that it is gravity, not less than the matter contained in a body, that determines its weight. The pressure of a lb. on the sq. inch is not the same on the top of a mountain as it is at the bottom of a coal mine, whereas its apparent equivalent—69,000 dynes per sq. cm.—is the same everywhere.

(To be continued.)

—o—

Publications Received.

Blackie and Son—
Vere Foster's Painting for Beginners. In 9 parts.
Trees in Pencil and Colour. By J. Needham. In 8 parts.
Miss Fenwick's Failures. By Esmé Stuart.
Winnie's Secret. By Kate Wood.
Down and Up Again. By Gregson Gow.
Warner's Chace. By A. S. Swan.

Chambers (W. and R.)—
Object Lessons. By C. McRae, M.A.

Crosby Lockwood and Co.—
The Compendious Calculator. By D. O'Gorman.

Derfel (R. J.)—
Science Simplified for Little Ones. By M. H. Senior.

Educational Supply Association—
The E.S.A.'s Test Cards. Standards II. to VII.
The Holborn Series of Poetry Books. Shakspere's King John, Mrs. Hemans, Byron, Longfellow, and Selections of Poetry.

Hickmans (D.)—
The Practical Register of Attendance and Fees. By W. J. Binns and D. Hickmans.

Hodder and Stoughton—
Andrew Marvel and his Friends. By Marie Hall.
The Children of China.
Economical Cookery. By Mrs. Addison.

Jarrold and Sons—
Free England. By H. E. B.
A Star in the Crown. By D. Darlinghurst.
The Teachers' Diary and Pocket Book, 1885.

Laurie (T.)—
A Grammar for Beginners. By E. Bartrop.
Kensington Table Cards.
The Graduated Arithmetic. Parts 1, 2, and 3, and Book of Answers.

Letts, Son, and Co.—
Letts's Household Magazine. December.

Longmans and Co.—
Johnston's Intermediate and General Geography.

Miscellaneous—
Second Annual Report of the Metropolitan Public Garden, Boulevard, and Playground Association, 1884.

Murby (T.)—
Murby's Excelsior Reading Books. Nos. 1 and 2.

Murray (John)—
Little Arthur's France.

Smith, Elder, and Co.—
The Cornhill Magazine. December.

Stock (Elliot)—
Experimentum Brevissimum. By H. T. M. Horne.

Swann Sonnenschein and Co.—
Scientific Romances. No. 1. By C. H. Hinton, B.A.
Systematic Cutting-out. By E. M. Brant.
Notes on Early Training of Children. By Mrs. F. Malleson.

Symons and Co.—
Meister Martin—German Classics.

The Practical Teacher.

A MONTHLY EDUCATIONAL JOURNAL.

To Subscribers.—The *Practical Teacher* is published on the 25th of every month. Price 6d.; post free, 7½d.; sent post free, three months for 1s. 11d.; six months, 3s. 9d. a year, 7s. 6d.

P. O. Orders should be made payable at Chief Office.

Subscribers not receiving their copies regularly are respectfully requested to write to the Publisher.

It would save time and expense if subscribers when remitting would state exactly what numbers they wish to be sent.

To Correspondents.—All literary communications should be addressed, THE EDITOR OF THE PRACTICAL TEACHER, Pilgrim Street, Ludgate Hill, London, E.C.

Accepted contributions are paid for within twenty-one days of publication.

The Editor cannot return rejected MSS.; authors should therefore retain copies.

TO ADVERTISERS.

Approved, *prepaid*, advertisements will be inserted in the *Practical Teacher* at the following rates:—

	s.	d.
20 words or under	3	0
Above 20 words and under 32 words ...	4	0
32 words and under 64 words	5	0
For every additional 10 words	1	0

Teachers Advertising for Situations.

	s.	d.
20 words or under	1	0
For every additional 10 words	0	6

For an ordinary page	4 guineas.
For page facing matter	5 guineas.
For 2nd page of wrapper	5 guineas.
For 3rd page of wrapper	5 guineas.
For the page opposite the 3rd page of wrapper	5 guineas.
For the 4th (back) page of wrapper ...	6 guineas.

Parts of a page are charged at a slightly higher rate.—Special quotations will be given for a series.

Portfolios, fitted with elastic bands, for preserving twelve numbers of 'The Practical Teacher,' may now be had. Price 2s. 6d. Orders should be given through booksellers.

The numbers of the *Practical Teacher* for February and March, 1884, are now out of print.

Publications Reviewed.

Shakespeare's Plays for Schools. Abridged and Annotated. By Charlotte M. Yonge. 'King Richard II.' London: National Society's Depository.

'King Richard II.' is one of Shakespeare's plays that for young readers needs least abridgment, and is one of those that need most annotation. The abridgment of Miss Yonge is, therefore, on the smallest scale. As far as we can see, she has only taken out the following passages:—Five lines in Richard's long speech to the rebellious and recalcitrant Mowbray and Hereford, after his indecisive action in preventing their necessary combat; eleven lines in Act II. scene 2., just before the entry of York; eight or nine in Act V. scene 2, one of which is in the middle of the speech of the Duchess of York beginning—

'Why, York, what wilt thou do?'

and the rest just before the exit of her husband; one more is cut out in the next scene.

As to these omissions they are almost all necessary for young readers. But the five in Richard's long speech might fairly, both to Shakespeare and to the student, be retained. They comprise two of the sweetest lines in the play—

'To wake our peace, which in our country's cradle
Draws the sweet infant breath of gentle sleep'—

lines of the more value as they have a faint ante-taste of the Macbeth line—

'Whom we to seek our peace have sent to peace'—

and will come back to the Shakespearean when the latter stronger line is read. The eleven lines in II. 2, must go; and so must the lines omitted in V. 2, and the line in V. 3. But we are not sure that Miss Yonge would not have exercised a wiser discretion in excising yet more at large the Duchess of York scene. This is doubtfully Shakespeare's, and is neither good English nor good play-writing.

The annotation is done well; the introduction is excellent; so is the summary of the play; so is the expansion of the list *dramatis personarum:* so are the notes and paraphrases—though a little carelessness in the matter of composition has led Miss Yonge to say that which we are sure she had not intended to say. The note on 'lewd' has the rather ambiguous phrase—'"lay" or "laity," in distinction to the clergy, and, as these were unlearned, lewd meant first ignorant, then wicked.' Nor is the unintentional slur on the clergy thus cast, in default of good English, atoned by a reference at the end of the note to Acts xvii. 5. The notes drop off fitfully towards the end of the play, but they are good, nevertheless.

Practical Help for Infants' Teachers. By James E. Singleton. London: Jarrold and Sons.

This is the work of a practical teacher, who is now engaged in the more responsible, and not less arduous, duty of examination and inspection.

The 'Methods of Instruction,' in Part II., exhibit intimate knowledge of the Code requirements and fertility of resource in meeting them. Infant-teachers are anxious for guidance in the new features of the Mundella Code, viz., the choice of a suitable series of object lessons, and the so-called 'varied occupations.' Mr. Singleton has already issued books on these topics. In the present volume most space is given to modes of teaching the 'three R's.' The method suggested for instruction in the early stages of reading is excellent; the alphabet is made attractive by processes of comparison and contrast afforded by the letter forms; experience and sound reason have combined to select reading and transcription for the most effective modes of teaching English spelling; number is made entirely dependent upon an abundance of concrete examples; the selection of object lessons affords sufficient variety of topics to awaken the interest, and stimulate the observation, of young children; at the same time sufficient connection runs through the subjects to exercise children in the valuable effort of grouping the knowledge imparted.

In Part I. the author attempts to state the principles of mental science upon which the various methods employed rest. We cannot give this portion of the book unqualified approval.

In the historical sketch of the several phases of a

schoolboy's career the incidents have been skilfully arranged and graphically stated. The paraphrases of Lesson III. into language suitable for the infant-school are particularly good. Indeed, the entire story, with its moral applications, might with advantage have been stated in the same simple and forcible language.

Chemistry Wall Sheets; Sheets I. and II. Edinburgh and London: W. and A. K. Johnston.

The above two large wall sheets will, if we mistake not, prove welcome accessories in the class rooms of teachers of elementary science.

Sheet I. is a clearly-printed and well-arranged tabulated statement of those substances which are at present classed as elementary, giving their symbols, atomic weights, and quantivalence. A noticeable feature, which distinguishes this sheet to some extent from other lists which have come under our notice, lies in the fact that the names of the more common and important elements are printed on a pink ground, and those of a rarer nature or of less importance on a blue.

Sheet II. deals with those features of natural science of which a due appreciation is necessary as introductory to the study of chemistry. Commencing with diagrams illustrative of Cavendish's experiments on attraction, there follow equally clear explanatory drawings of cohesion, capillarity, specific gravity, osmose and diffusion of liquids and gases, etc.

The handbooks supplied with the sheets are lucidly written, and supply abundant information, not only for intelligibly understanding the various plates, but also for obtaining a wider insight into the subject-matter.

Natural History Plates. Edinburgh and London: W. and A. K. Johnston.

Teachers will welcome these remarkably effective illustrations of animal life. Those we have personally inspected leave little to be desired either in accuracy of drawing or effectiveness of colouring. They are of fair size, and of bold design, and are thus well adapted for use with large classes.

Types of Nations. A Series of Wall Sheets. Edinburgh and London: W. and A. K. Johnston.

It would be hardly possible for young people to acquire a clear idea of the personal appearance and dress of the inhabitants of foreign lands were not some assistance of a pictorial nature afforded them. Judging from the two or three specimens we have seen of the above series, the illustrations therein given to supply this want seem exactly to meet the requirements of the case. As a rule the accessories in the pictures are made to convey as extended an idea as possible not only of the appearance and dress of the people represented, but also of their customs, and the natural productions of the country they inhabit. An exception, however, is to some extent made in the case of the Chinese; for, oddly enough, the drawing illustrative of that peculiar race contains no allusion to two facts peculiarly typical of them—the use of their natural beverage—tea, and the custom prevalent amongst ladies of the higher classes of cramping their feet into tiny triangular shoe-lets.

Object-Lesson Pictures for Schools: Fruit Trees. London: A. Johnston.

This series of coloured illustrations is uniform with the Useful Plant series emanating from the same publisher, and is equally deserving of praise. The size is a serviceable one—25 inches by 20, being neither too large for portability, nor too small for general class use. The drawings are clear and effective in colouring and design, and they will undoubtedly prove useful and instructive adjuncts in connection with the giving of object lessons.

First Natural History Reader. For Standard II. According to the requirements of the Revised Code. Quadrupeds and Birds. London: Marshall, Japp and Co.

To paraphrase Portia's line—'The code requires it, and the publishers give it.' This is the expression of the *raison d'être* of legions of books that would not otherwise have seen the light of children's eyes beating upon them. The 'requirements of the revised code' also lead to the use of the name 'natural history,' not in its original sense of an account of natural phenomena generally, but in its limited sense as an account of zoological phenomena particularly.

The same 'requirements' are, doubtless, responsible for the bad order in which the various animals are discussed in this volume. Not only are the quadrupeds studied before the birds, that is the higher class before the lower, but a like misplacement is observable in dealing with the Primates. The order is, to use a commonplace phrase, 'neither one thing nor the other.' Thus the monkeys are taken first, then the apes, which are higher than the monkeys, then the long-tailed monkeys, lower than the monkeys.

Of general criticism, only one or two points present themselves. Is it quite wise to refer to 'hundred-weights' in a book for Standard II., or to speak of 'camel's-hair pencils' without explaining that a 'pencil' is a brush? We could wish also that a question that, in our youth, vexed us sorely had been solved for the present generation that rises. This is the question of the difference between the crow and the rook, a difference easily pointed out to young students.

Turning to special criticism, there are scarcely any actual blunders in the book. Seeing that the order Bimana is now an exploded one, and that the name Primates is used preferably to that of Quadrumana for the highest order of the class Mammalia, the order including man, apes, and monkeys, we think it is unadvisable to speak of the last-named as 'four-handed animals' (p. 2), in contra-distinction to man as a two-handed Primate. The dentine of the teeth (p. 37) is not soft bone. As these are the only scientific points that we can subject to adverse criticism, it will be gathered that the science part of the work is well done.

We wish we could say the same for the literary side of the book. The English is not all that is desirable. Change of tense, as on page 4, 'will' for 'shall' (p. 9), inelegancies like 'on next page' (p. 17), tusks 'as *large* as fourteen feet *long*' (p. 28), 'only the front of these four teeth are coated' (p. 37), are instances. The *bête-noir* of the average writer, 'which,' haunts the author of the Natural History Reader. Pages 13 and 69 are in evidence. 'They have toes of a peculiar form which enables them to do this.' And that vagueness in the use of pronouns that seems to be a fatality with writers on elementary science is also to the fore. Pages 6, 10, 20, may be mentioned, and on page 48 we have three sentences running thus: 'The strong claws aid *it* to dig . . . in search of ants and other insects on which *they* feed. *They* are very swift. . . The AmericanIndians esteem *it*.'

Occasionally a little ambiguity is noticeable. It is not quite clear, *e.g.*, how the camel's hump serves as food to the camel (p. 30). An imaginative child might think that the camel actually turned its head round and browsed, so to speak, upon its own back. Nor are the alveolar cavities in the camel's stomach described very clearly. And the following expressions are somewhat open to misconstruction: 'The kingfisher has a beak like the bee-eater, but it is quite straight and four-sided. Its legs are short.' 'People keep fowls because they lay plenty of eggs.'

The writer might, without making his work over-difficult, have touched lightly on homologies. That a bird's wing is a modified arm, that in the short neck of the elephant or of the whale there are as many bones as in the long one of the giraffe, that feathers and hairs are of kindred nature are truths not too deep for children and

are ideas that would lead them early, as they should be led, to the observation of unity of structure. The omission is the more noticeable as on pages 18, 22, the writer has taught without any undue forcing the doctrine of colour-mimicry in animals.

The moral teaching is introduced unobtrusively and even delicately (see p. 21), though we regret that the accounts of man's cruelty to the lower animals are given without a word of pity. The cruelty may be 'necessary' (in the opinion of man). Nevertheless the account of whale-hunting (p. 23), and of deer-stalking (p. 37), would bear as supplement some passing expression of regret at least.

Wall Map of Palestine. London and Edinburgh: W. and A. K. Johnston.

This wall map is well designed to suit the uses for which it is intended. The positions of the various places are marked clearly and judiciously, so that, while the map contains all the places necessary for even the advanced Bible student, there is no appearance of crowding, and the legibility is in no way interfered with. The map is divided longitudinally into two portions, that on the left representing Palestine in Old Testament days, that on the right in the time of the New. There are also two subsidiary maps illustrating the city of Jerusalem and the district in its immediate vicinity.

Without in any way reflecting on native talent in the matter of map-producing, we would venture however to express a hope that the lessons conveyed by the display of Continental school maps at the recently closed Health Exhibition may not be without their effect, and that some of the really excellent productions there shown may furnish British map-makers with a hint or two of which they will not be slow to avail themselves. One physical map of Europe—in the French exhibit, if we remember aright—seemed to us particularly happy and effective for school use. The sea, lakes, and rivers were of a bright turquoise blue; the land of a warm brown, graduating into lighter shades and into pure white as higher levels were reached. The configuration of the mountain chains was plainly marked by appropriate light and shade, and an effect was obtained very similar to a raised map with a strong light thrown diagonally across it. The rugged ranges of Central Europe, and the wide plains of Russia and North Germany were equally well exhibited by this plan of colouring, and the effect of the map altogether was such as to emphasize and bring into remarkably clear contra-distinction the divisions of land and water, and the varying levels of the land-surface.

John Wicliffe, the Morning Star of the Reformation. By David J. Deane. London: S. W. Partridge and Co.

The quincentenary of this Reformer and patriot occurring this year has brought his name prominently before the public. Mr. Deane tells the story of Wicliffe's life in a pleasant, unbiassed fashion. We are inclined to think that sufficient credit has hardly been given to the Reformer for his exertions in the cause of freedom, and we are glad to notice the prominence which is given to that part of Wicliffe's work by the author. To those who have not leisure to examine larger works this 'Life' can be heartily recommended.

Chambers's Graduated Readers. Book V. London and Edinburgh: W. and R. Chambers.

This book maintains the character of the series of which it forms a part. It consists entirely of extracts from standard authors, and the selection is one which meets with our entire approval. There is not an unsuitable piece in the whole book, nor one which is beyond the capacity of the children for whom the book is intended. A short introduction is given to each selection, and the addition of a list of words and word-building exercises adds greatly to the educational value of the book.

Readings from Sir Walter Scott. London: Blackie and Son, 49 and 50, Old Bailey.

If the schoolboy of the present day does not acquire a taste for the best literature in the English language, it will not be for want of opportunities of becoming acquainted with it. Messrs. Blackie and Son here present us with a selection of connected stories from the 'Wizard of the North.' The book is thoroughly well-suited for a reading-book. Besides extracts from *The Talisman*, *Ivanhoe*, *Anne of Geierstein*, and *Marmion*, it has a biographical sketch of the author, explanations of words and allusions in the text, a list of words derived from Latin, with their roots, and the Latin prefixes. It is strongly bound and well printed, and is issued at a reasonable price.

Geographical Reading-Books.—The British Islands. By Thomas Parry, F.R.G.S. London: Longmans, Green and Co.

The respected author of this reading-book passed away before it issued from the press. He was a practical teacher, of proved ability, and the pages show the skill which he could display in arranging and presenting useful information. The book, however, while suitable as a reading-book, does not cover the ground required by the Code. It contains more than is required for Standard III., and less than is expected from Standard IV. Where a teacher chooses his own course of lessons, and adopts a method of division different from that commonly selected, the book can be used with profit; but as geography is supposed to be taught now from reading-books, a teacher who selects this book for either of the standards named, expecting to find its contents suitable for the Code, will be disappointed.

The Queen and Her Relations. London: Henry G. Davies, 73, Ludgate Hill.

A sheet containing a table of the descendants of George III., another of the Danish Royal Family, and a third of the descent of Her Majesty from Alfred the Great, is thus named. It is more complete than the tables usually found in histories, and, to any one wishing to know the number and the connections of the present Royal Family, will be very handy.

The Young England School Series.—Geographies. Standards I. to VII. By S. B. Tait. London: Jarrold and Sons, 3, Paternoster Buildings.

Teachers who use the Empire Series of Home Lesson Books will at once recognise these six little books as reprints of the geography lessons in that series. They are well printed, though the type is somewhat small; and can be used as memory-books with any set of geographical readers. The information is correct, concise, and full. From twenty to fifty Inspectors' Questions are given with each book.

Arithmetic. Standards I. to VII. London: Jarrold and Sons, 3, Paternoster Buildings.

Like the preceding books, these are also reprints, with additions, from the Home Lesson Books named. The examples are well graduated, and contain many specimens of Inspectors' Sums. The type, however, is much too small, although the printing is good.

Daisy Snowflake's Secret. By Mrs. G. S. Reaney. London: Hodder and Stoughton.

Mrs. Reaney in this volume traces the history of an orphan placed among relatives in a well-to-do family, whose life was overshadowed by the necessity for keeping secret the habit of intemperance into which her aunt had fallen. The story is simply and naturally told, and deals with a phase of home life which we are sorry to believe

is much more common than formerly. We heartily wish for the book a wide circulation, assured that its influence will be for good, although we find it difficult to bring ourselves to believe that there are many medical men who have deliberately come to the conclusion that they must refuse to give up sanctioning the use of intoxicants simply because it 'would not pay.'

The Eclipse Arithmetical Test Cards. Standards II. to VII. London: The Educational Supply Association (Limited), Holborn Viaduct.

These cards have the manifest advantages of good printing, stout cards, and strong cases. There are twenty-eight test cards, and a card of answers in each packet. Each card has eight sums, divided into two sets of four each, thus serving as a double test for two different periods of the year. The problems are very good, but are somewhat difficult in the Fourth Standard. The set supplied to us contains four imperfectly cut cards in the Fifth Standard, and two sets of Standard VII cards have been sent instead of one each of Standards VI. and VII.

Akrill's Arithmetical and Spelling Cards. Standards I. to VII. Lincoln: Charles Akrill, 253, High Street.

This set comprises seven packets of extra-stout well-printed cards, compiled to answer the purpose of test cards in arithmetic, and of supplying spelling exercises as well. The sums have been well constructed, and a novel feature of the cards is that of printing the word denoting the requirement of the sum in bolder type.

The spellings have been so arranged as to give words of one syllable to the First Standard, two to the Second, and so on, apparently without any regard to the suitability of the words otherwise. This leads to some strange requirements from young children, such as *rheum*, *pshaw*, *newt*, *lymph*, and *quartz* for Standard I.; *catarrh*, *epergne*, *façade*, *phthisis*, and *poignant* for Standard II.; *æsthetic*, *coalesce*, *rendezvous*, *surveillance*, for Standard III.; and other equally unsuitable words for Standards IV. and V. Standards VI. and VII. have Latin prefixes and roots respectively, with examples and meanings.

The Practical Register of Attendance and Fees. By W. J. Binns and D. Hickmans. London: John Marshall and Co., 42, Paternoster Row.

The *Practical Register* is very well printed, on good paper, and in a stout cover, strengthened by a band of cloth up the back. The four principal openings each contain spaces for fifty-five names, with the various particulars necessary for fees and attendances only. There is no fly-leaf. The compilers state that their chief aim has been to save the time of teachers, and to avoid all unnecessary labour. To this end they devote the first two pages to what they call the 'essential requirements of a Register.' By the use of these pages such entries as 'Admission No., Date of Admission, Date of Birth, and Last Standard,' are required to be written once only.

In these particulars the *Register* fulfils the aims of the compilers.

A direction at the head of these pages says that names should be arranged alphabetically. It would have been well if a direction had also been given *how* to do this after the commencement of the school year, especially in schools where the number admitted is often equal to the number on the register. A supplement to the Admission Register in the shape of columns for 'Parents' Name,' and 'Last School,' to be used for admissions during the year, is a doubtful way of saving teachers' time. In districts, too, where children are migratory, a column for residence is necessary at each opening of the register; changes of residence being so frequent, that a space for a new address is absolutely needed. In country districts and small towns, this, of course, does not apply, and even in towns, the columns 'Parents' Name' and 'Last School' could be utilised for changes. We have not yet seen a perfect register, but the *Practical Register* comes as near perfection as any hitherto published, and teachers anxious to get one well-suited to different classes of schools might 'go further and fare worse.'

Higher Education in Germany and England. By Charles Bird. London: Kegan Paul and Co.

An admirable little book, whose issue just now shows the astuteness of the eminent publishing firm under whose auspices it sees the light. The compiler—Mr. Bird would be the first to claim this more modest title in preference to that of author—has done good work well. Almost nothing occurs in this volume to which even that hypercritic, the reviewer of books on education, can take exception. There may be a hint that Mr. Bird is not without an eye to future inspection of his own school, or possibly even to future inspectorships, and there certainly are one or two examples of English that Mr. Bird would not commend in others, and that we cannot in him. It may be urged that his German studies have, in some measure, impaired his English, or that the head-master of a mathematical, need not be so particular as the principal of a grammar, school. Nevertheless, 'Most people have a vague idea that they are somewhat ahead of us abroad in their educational arrangements' (page 5), and 'Geometry, and parallel with it geometrical drawing . . . begins,' are not, as sentences, all that they might be.

Another grumble may be not unfairly directed against Mr. Bird's want of system in the treatment of one part of his subject. This want is the more noticeable as it is itself, for the most part, wanting. For example, all the account of the time devoted to particular subjects in the various grades of German schools and of the topics and books considered under each subject is thoroughly systematic. The one part of the account of the educational arrangements in Germany that is not quite clearly marked out is the classification of the different kinds of schools.

The list of schools now to be given has to be compiled from pages 9, 31, 81, 88, 91. At the very outset, as we think, for the English reader a list of the establishments to be found in such a town as Stuttgart ought to have been given. These are from below upwards (1) The Volkschule (people's school)—our public elementary school; (2) The Burgerschule (citizen school) — our middle-class school; (3) The Realschule, or scientific school; (4) The Realgymnasium, half scientific, half classical school; (5) The Gymnasium, or classical school. All the three last have no exact parallel in England, but they are all higher grade schools. (6) The Polytechnic, a university for the Realschule pupils, as (7) The universities are for those of the Gymnasium; (8) The Fortbildungschule—our mechanics' institute; (9) The Baugewerkeschule, or technical school; (10) The Kunstgewerkeschule, or art school. It should be noted here that the system of schools is not as uniform throughout Germany as Mr. Bird would have us believe.

What a contrast with this beautiful series of State schools is our higgledy-piggledy educational chaos! The English 'system' is, as Mr. Bird says, 'of the most fragmentary and casual description, and the disgracefully low condition of education in this country will be gathered in part from the following painfully significant figures. In 1868 the number of students available for higher education was in England about 1·6 per cent. In Stuttgart the number is 5·2 per cent.'

In almost every point the German method of tuition is better than ours—as much better as their plan of master-training. Repetition is much in vogue. Not of a lesson, of course. That torture of the student and ignominy of the teacher is passing rapidly away wherever teaching is at its best. Repetition of the work already done is utilized at all stages of the work. Note also the excellence of the plan for teaching Geography. Instead of

beginning with the World, of which a child has rather less knowledge and certainly a less definite conception than he has of the sun or the moon, the Germans commence with the geography of the town in which the school is, and so work outwards to province, country, continent. Professor Huxley began his Physiography on a kindred plan, but appears to have grown weary by reason of the way as the book went on.

One comment on the part of Mr. Bird would be amusing were it not somewhat surprising as coming from the head-master of a mathematical school. He tells us that 'the Germans have got over their veneration for antiquity so far as to discard Euclid as a geometrical text-book.' Surely, Mr. Bird knows that in all our best schools Euclid is no longer used, and that the modern geometries, such as that of Hamblin Smith, have this long while taken its place.

The German lesson-books give the compiler an opportunity (he avails himself of it) to protest in passing against that school of reviewers who, ignorant of teaching, sneer at certain books as cram books. To the critic who, in his ignorance, does not know that the books of students are not to be committed to memory, but are, under the guidance of a skilled instructor, to serve as books of suggestion and of reference, these books are an enigma. Unfortunately for our non-educational critic, all the German school-books are of the type he condemns, and it would astonish him were he to see the use to which they are put by a good teacher in drawing out, literally educating, the mind of an apt pupil.

Space fails, or we should like to tell the reader of the absence of the chronic attack of external examinations, of the hours, of the punishments (there is little corporal), of the certificates (not prizes), of the low fees, of the State regulation of studies in all German schools. For these and many another interesting point he must turn, and he will turn if our advice is followed, to Mr. Bird's excellent little work. There he will learn that in educational matters 'they manage these things better in' Germany.

The Oxford and Cambridge French Reader. By Frédéric Hunt. London: Hachette et Cie., 18, King William Street, Charing Cross.

Here is a book that is certainly good to the eye. None of the beginners for whom the volume is intended will be frightened or even wearied by bad paper, coarse printing, or that worst form of book-ugliness, overcrowded pages. Nor does this Reader merely

> 'Keep the word of promise to our eye
> And break it to our hope.'

The book is well done; so well, that it is worth while pointing out one or two things that seem to us blunders, and that are certainly remediable. The Preface, brief as it is, wants re-writing. The queer mixture of French and English in the name of the compiler of the book finds its reflex in the first line of the Preface. 'A precious time is often wasted.' And the phrase, 'it stands to reason,' a few lines lower down, is too colloquial for the dignity of a Preface.

More serious is the criticism on the method adopted in some parts of the book. A division is made into parts corresponding with two years of instruction, and three terms for each year. A chapter on Pronunciation opens the work of each year. We have always held that the attempt to teach pronunciation by any method other than the living voice must fail. Our contention is not modified by Mr., or is it M. (?), Hunt's book, though by use of columns, brackets, and other devices the author tries to 'temper the wind to the shorn lambs' of learners. But our adverse criticism is something more than general. The first two lines of the actual book run thus: 'The tonic accent is placed on the *last* syllable: on the *last but one* when the word ends in *e mute*. Ex. *Constitution, magnifique.*' Placing on one side the fact that the first phrase is enough to make any well-regulated child want to run out and play at once, we have in the word *constitution* an example not well chosen. To frighten a child on the very threshold of learning a language with 'tonic accents' is unwise. And the word *constitution*, as an illustration of an accent on the last syllable, presents this difficulty. 'Tion' in French, as in English, is very doubtfully monosyllabic. Some such unmistakable word as *beauté* should have been chosen. Again, it is open to question if a child, even at the end of a year's study, ought to be threatened with 'penultimate' (p. 81).

Want of judgment is, as we think, shown in making all the twelve lessons of the first term of the first year consecutive portions of one and the same story. On the other hand, the lessons of the later terms are, with two slight exceptions (5th and 6th, and 11th and 12th of term 2), each complete in themselves. It is surely the younger rather than the more advanced who ought to have their exercises and tales each complete in itself, as children are fed with spoon-meat. And this long fairy story in twelve numbers is a little unfortunate in bringing in at the close of its very first part the idea of a mother who tells lies about her own age and that of her child in order that she herself may appear younger than she is. The idea is an over-true one. But it is over-early to introduce beginners in French to our society manners, and to teach the hollowness of these with a mother for illustration.

In the extracts given for reading during the second year Mr. Hunt has shown excellent judgment and catholic taste. The names of Diderot, La Fontaine, Rousseau, De Staël, Voltaire, Buffon, Fénélon, Dumas, Chateaubriand, Hugo, Michelet, Molière, De Musset, speak for themselves, and also for the compiler's width of reading and cultured taste. Poetry is, as more than one name in the above list tells us, introduced, and introduced with careful graduation of its intrinsic difficulty. Seeing that pronunciation is treated in the book, the omission of the rules for reading French poetry seems a grave one.

Essay Cards. By E. Noble. Manchester: J. R. Ledsham, Corporation Street.

No subject of examination in an elementary school tests better the intelligence of the teaching than does the effort at composition which is required from Standards VI. and VII. Unless ability to express himself in fairly good English, and with some degree of order and method, has been gained by a pupil, we may safely conclude that the teaching has been mechanical rather than educative. It is, therefore, absolutely necessary that good models only should be placed before a pupil. A bad style does not need acquiring; it comes naturally, and if bad models are placed before scholars, they are only confirmed in habits which have through other agencies been already acquired. These Essay Cards—thirty-six in number—have been written as models for the upper standards in schools. Although the subjects have been well-chosen, and have considerable variety, we cannot recommend them for the purpose for which they have been designed. They are very unequal in merit, and the majority are marred either by inaccuracy or peculiarity of expression, or both. About Spring the author says, 'Spring is rightly named, for it is the time when *young things spring up.*' However true this may be in some respects, the expression is, to say the least, inelegant. On card 3 we read, 'The fall of the leaf is sad in one sense,' and immediately after, 'But there is nothing really sad.' Want of order is peculiarly noticeable on card 4. Here we read, 'Winter has its peculiar pleasures, as well as summer. It is a trying time to the poor who have not fire, food, and clothing to defy the stinging blasts!' Surely, the beholding the misery and wretchedness of the poor is not a peculiar pleasure, although the relief of the distress may be. About 'stage-coach travelling,' we are told that 'the poor outsiders were glad to muffle themselves up in their great coats, *if they had any.*' They would have been clever, indeed, to have wrapped themselves up if they had not the means for doing so. A new reason has been found for wishing for holidays, for we are told that 'They are

peculiarly welcome at Christmas, because they come in the midst of the dreary winter, when the days are short, often dull and piercingly cold.' The Irishmen who come over to help us to get in our hay-harvest 'look strong and brown, though the frequent wettings sometimes bring on *rheumatic* in later years.' And so we might go on through the packet; but we have not space to make further quotations, and can only say in conclusion that we should read these essays to the class, not as models, but as showing the mistakes to avoid in writing an essay.

Cassell's Modern School Test Cards. By George Ricks, B.Sc. London: Cassell and Co., Limited, Ludgate Hill.

Each packet of these cards is divided into two series, of twenty each, the latter series containing examples slightly more difficult than those of the former. The examples are very varied, and of different degrees of difficulty, and yet they are fairly within the capacity of an average school. Examples are frequently given in the work of the previous standards; a knowledge of previous rules is thus maintained. Such expressions as Change fourpences into threepences,' and 'Change guineas into sovereigns,' should be avoided. A child, in any standard who has worked through a set of these cards, will find little difficulty in passing the Government examination.

The True Test Arithmetical Cards. By W. Watson. Blackburn: H. Isherwood, 9, Northgate.

These cards are free from those objectionable problems designed, not to test the intelligence of the scholars, but to prove a source of irritation to the teacher, and pain and dismay to the scholar. They are quite difficult enough to form a true test of the ability to work practical examples in arithmetic.

The London Arithmetic Test Cards. London: William Isbister, Limited, 56, Ludgate Hill.

The London Test Cards can be recommended to teachers seeking a set suitable for the majority of children. The sums are practical, and not too difficult, while they give ample variety. Considerable ingenuity has been displayed in making the examples, and the method of checking the answers is equally ingenious and simple.

Paragon Arithmetical Examination Cards. By J. S. Horn. Manchester: John Heywood, Deansgate.

The series with the above title is said to be specially designed for the Mundella Code. Each packet contains twenty-five cards, with eight sums on each card divided into two sets of four. There is a great similarity in the wording of many of the examples, and, as the whole of the questions in Standard I. are in figures, for examination purposes they will be useless in those districts where the sums are invariably dictated. The type is very small, and in many places the printing is indistinct. With these exceptions the series is a suitable one, and may be used with advantage as an alternative series. The answers are not published with the cards, but in a separate book.

Prairie Pictures: Lillith and other Poems. By Jno. Cameron Grant. London: Longmans, Green, and Co.

'Songs from the Sunny South' and 'A Year of Life' have come from the same pen, and Mr. Grant seems to have published these poems in answer to an appeal from a critic of his former works. We cannot say that his reputation will be much enhanced by the present publication; for while the short poems, which give the principal name to the book, show great accuracy of observation, they also contain many crude lines, put together almost regardless of rhythm, and are in several instances on subjects which do not readily lend themselves to poetical treatment. Perhaps the peculiar stanza adopted has something also to do with the want of smoothness which marks the verses; for when the author adopts the sonnet, as in 'After Dark' (in our opinion the best of the pictures), or blank verse, as in 'Over Sea,' he is much more at home, and his thoughts seem to obtain readier utterance. Mr. Grant is anxious to impress upon his readers the boundless wealth of food and space which the grand possession of Canada gives to the people of this country. His poems tell of a nature full of deep religious feeling, and of active sympathies for the poor outcasts of our overcrowded cities. Intense hatred is manifested towards those who seek for place and power only that they may serve themselves.

Of the ultimate triumph of truth and right over falsehood and wrong, the author discourses with great freedom and certainty in the poem 'Vicisti,' and he shows his ability to write true pathos in the poem of true heroism which he has called 'In Memoriam.' Notwithstanding the apparent haste displayed in writing some of the earlier poems of the book, and their want of revision, Mr. Grant will bear reading more than once. His poems grow upon one, and new beauties show themselves on every subsequent perusal. This, we believe, is one of the surest tests of a true poet. We have not space for quotation, but must refer our readers to the book itself, in proof of the correctness of our views. Several typographical and orthographical errors have crept into the otherwise well-got-up book. We get *tho* and *thro* for *though* and *through*, all through the book; on p. 41 we have *e're* for *ere*, and *fairy* in two forms, *faerie* and *faery*, on separate pages. On p. 2 we have *quiet* for *quite*; on p. 13, *bires* for *byres*; and on p. 19, *stemed* for *stemmed*; on p. 27, *convolvolus* for *convolvulus*; on p. 32, *thro* for *throw*; on p. 37, *urks* for *irks*; on p. 44, *t'was* for *'twas*; on p. 45, *t'would* for *'twould*; on p. 52, *lovlier* for *lovelier*; on p. 55 the old form *agen* for *again*; on p. 67, *lovliest* for *loveliest*. Some of these may be modern methods from across the Atlantic, but till there is some common desire expressed to adopt a different kind of spelling, we think it well, in English-printed and English-published books, to adopt the generally accepted forms.

The Children's Pastime. Pictures and Stories. By Lileth G. Séguin. London: Hodder and Stoughton.

In books meant for children every picture should tell its story, and every story should present a picture, and both pictures and stories should be very beautiful. But in this volume there is no beauty of any kind. All, with the exception of the binding, is hopelessly ugly. It is difficult to say which is worse, the stories—with their slipshod English, and equally slipshod sentiment, their dulness and morbidity—or the pictures, which are simply indescribable. On the title page we are told that Millais, W. Small, F. A. Frazer, E. G. Dalziel, and others are responsible for the 'illustrations;' but it seems incredible that such artists can have had any hand in a production so thoroughly inartistic. Their co-operation can only be explained on the hypothesis that they have allowed old pictures of theirs—and the clothes of the men, women, and children presented all fix the date of the drawings at least twenty years ago—to be used, and that many and cruel liberties have been taken with their work. That the painter of Cinderella and Little Red Riding Hood could have drawn the sickly children in 'Gerty's Unlucky Day,' or the little monster Morna (p. 165), is impossible. That W. Small could be responsible for the abomination on p. 145, we refuse to believe. Death, Madame (or Madlle.) Séguin apparently thinks a cheerful and appropriate subject for little children. There is a 'Farewell' to be sung 'slowly, and with expression;' a 'Young Widow,' a 'little grave,

sundry orphans. And she also wants the little ones to know all about 'Baby Shows!' Madame Séguin calls her book the 'Children's Pastime.' We think it more likely to be their nightmare.

Andrew Marvel and His Friends. By Marie Hall. London: Hodder and Stoughton.

It is very pleasant to turn from Madame Séguin's book to Mrs. Hall's, which we are not surprised, but very glad, to see has reached a fourth edition. Despite her ardent sympathy for the sturdy 'Ironsides' and her contempt for the Stuarts, Mrs. Hall is never unjust. She does not assume that a man must be necessarily good or bad because he is a 'Roundhead' or a 'Cavalier;' she is a very faithful historian, and an artist. Both her fidelity and her true artistic instinct are shown in her rejection of the old and untrue version of Marvel's death by poison, for the less romantic, but really more pathetic and effective one, the details of which we owe to Dr. Gee.

Mrs. Hall has given also another proof of her ability. While she makes us take a vivid interest in Marvel; while she succeeds in making us know him 'in his habit as he lived'; he rarely appears in the story itself. We know him through his friends and his effect upon them. To have introduced the great satirist would have been, to say the least, rash.

We have but two faults to find with this excellent work, and they are so trivial it seems almost ungrateful to speak of them at all. In the first place, the heroine, Alice—sweet, and strong, and lovable, though she be—is perhaps a little too much given to a nineteenth century habit of introspection. In the second place, Mrs. Hall does not make sufficiently clear the reason why the Royalists were so anxious to seize Hull. She forgets, no doubt, that her readers are not all such well-read historians as herself, and that many must have forgotten that Hull was, in Green's words, 'the great magazine of the North.'

The volume is very beautifully illustrated by lovely sketches of old Hull, and there is a splendid photograph of Andrew Marvel's statue.

Heroic Adventure. Chapters in Recent Exploration and Discovery. London: T. Fisher Unwin.

This is a most able compilation from the works of some of the greatest explorers of our day. It will be welcomed by those grown-up people whom a long course of magazine reading has rendered incapable of getting through a volume, and who want to have the salient points of a book put into a few pages for them. It will be welcomed by all the young folk who love tales of stirring adventure. The boys and girls must be *blasés* indeed who are not moved by the efforts of such men as Schweinfurth, Prejevalsky, Markham, Vambéry, Serpa Pinto, and Nordenskiöld.

The compilers of this volume have wisely allowed the heroes, so far as possible, to tell their own stories; and not the least charm of this fascinating volume lies in the perfect simplicity, the unconscious grandeur of the narrators. We know many books with 'a moral purpose' that teach no such moral as this book, in which the 'purpose' is never allowed to obtrude itself. Boys and girls will be the better and the braver for reading of these brave men, who, for the sake of science alone, perform deeds of heroism by the side of which the acts of the boldest soldiers seem insignificant.

The accounts of some of the adventures are so wonderful that we feel they must be true. By the side of them Othello's experiences seem commonplace, and his 'men whose heads do grow beneath their shoulders' are not half so interesting as Schweinfurth's little 'pigmies,' whose 'average height is four feet ten inches.'

To grumble is the privilege of the Englishman and the reviewer, and even this book 'shall not escape.' Surely, in a book meant for boys and girls it would be well if such words as 'ethnological' and 'orthognathous' (which, by the way, is mis-written 'orthognatic') were explained; and if small maps, illustrating the regions described, were added, they would add incalculably to the use and profit of the book. The binding, but for that gold band across, and the illustrations are very good.

Magna Charta Stories. Struggles for Freedom in Former Times. Edited by Arthur Gilman, M.A. London: Blackie and Son.

There is a 'plentiful lack' of chronological order in this otherwise very excellent little book. To be suddenly transferred from the times of John and his barons to that of Horatius, or Miltiades, or Leonidas, or Hermann, or Alfred the Great, or Charles Martel, is somewhat perplexing.

Three of the twelve 'stories' are told by the editor, the rest by different ladies, all of whom we suspect are Americans. The name of one of them, at least, we all know—that of Nathaniel Hawthorne's daughter. As to the editor himself, his speech bewrays him. On p. 56, and again on p. 59, when wishing to give us an idea of the smallness of Attica, he compares it to Massachusetts and Rhode Island. We cannot think an Englishman would have selected either as terms of comparison.

All these stories of the great men who fought for freedom, and who 'loved honour more' than aught else, are well told, conveying most pleasantly some knowledge of many great historical events. On p. 117 we note a curious error. We are told that Napoleon 'made famous' the motto '*Toutefois l'audace.*' To begin with, '*toutefois*' would mean nothing; and secondly the words '*Toujours de l'audace*' or '*Encore de l'audace*' were spoken not by Napoleon, but by Danton. The printing, binding, and illustrations of this book are admirable.

Bunyip Land. By G. Manville Fenn. London: Blackie and Son.

'Bunyip' is the name a black boy, an Australian, gives to evil spirits, and Bunyip Land is New Guinea. Hither come Joe Carstairs, his faithful black follower, his friend a young doctor, and an eccentric youth, Jack Penny, not forgetting Jack's dog Gyp. They have come to search in the interior for Joe's father, a botanist, who has disappeared, and who has not been heard of for three years. Of course, Professor Carstairs is found at last, but after such numbers of thrilling adventures that, but for our certainty that the hero will 'come through' all right, we should be quite unhappy. We are sure boys will delight in this splendidly 'got up' volume, and we are much mistaken if Jack and his dog Gyp are not the great favourites, and preferred to Joe, who is something of a prig.

Menhardoc. By George Manville Fenn. London: Blackie and Son.

This is a really charming story of 'Cornish nets and mines.' We do not know if the 'local colouring' is all true, but we do know that this story will delight all the boys and girls who are lucky enough to have it given them. We are sure also that next summer many a paterfamilias will be coaxed by his young hopefuls into taking a trip to the West.

There is, however, as it seems to us, one serious fault in this book. 'To get on' is the chief doctrine enforced. Perhaps it were wiser to teach our boys there is something greater and better even than 'getting on.' Again, we think Mr. Fenn weakens his teaching when he tells boys all an *English* man is expected to be, rather than what an honest, brave man is. We must confess, too that we are unable to reconcile ourselves to the theory of 'Mr. Temple,' that, because he has capital, he is justified in taking three-fourths of the 'works'—which he has

only been able to make anything of through the skill and knowledge of the sailor lad, Will Marion—thus leaving the discoverer of the 'lode' only one-fourth of the profit.

All these objections, however, will not prevent this story from being as popular as it deserves to be.

Science Simplified for Little Ones. By M. H. Senior. Manchester: R. J. Derfel.

This little book, we are told in the preface, is intended to familiarise children with the chief facts of science before they enter the regular classes. At what age they are supposed to enter the regular classes we are not told; but as the author says that it can be used either as a reading-book or a compendium of home lessons, when one article can be learnt at a time, we may assume that the book is intended to be read and learnt. What sort of statements, then, are children to learn under the name of science? The book contains ninety-eight lessons, one to a page. There are no illustrations, no connection between the subjects, no gradation in the difficulty of the lessons. The first lesson is on the fish, the second on the bird's eye, the third on the sleep of plants, the fourth on railways, and the fifth on the atmosphere. The seventeenth lesson to the little children, 'whose limited understandings' have not yet qualified them to enter the regular classes, is on centrifugal and centripetal force. Of course, the subject is utterly unsuited to such children. And how is it presented? Reference is made to a can swinging round by a string, and to the fact that if the string broke the can would dart off. 'This wish,' the author says, 'to get away is called centrifugal force.' 'Now, while the can is anxious to fly off, you are really pulling it to the centre; and if it suddenly gave up its desire to leave you, it would drop on your shoulder or fall to the ground. This drawing towards you is called centripetal force, and when the two are acting together on a body, that body will always proceed in a curved direction.' This is a preparation for a future study of dynamics. On page 37 the child is to be taught that 'thermometer' means a measurer of heat. And so on throughout the book. How sad it is that the heads of little children should be filled with inaccurate and useless statements, which waste their time and prove a positive hindrance to any future progress!

With children the all-important thing is to lead them to observe carefully, and to express accurately, what they see and hear and feel. The innate curiosity needs encouragement and direction. The retentiveness of their memories should be taken advantage of to store up really useful knowledge, such as the words of their own language, or of French and German, and not to learn by heart statements which they do not understand, and which, indeed, as in this case before us, are misleading or untrue. Surely it is not too much to hope that with the newer lights on the theory and practice of education, books like this so-called 'Science Simplified' will be entirely unknown. It is written on an entirely wrong principle, full of useless statements, often false, and certain, if it falls into the hands of scientific men, to bring discredit on the teachers who used it.

'The magazine reader will find no better investment for his sixpence.'—PALL MALL GAZETTE.

'The "Cornhill" is the most interesting of English magazines.'—VANITY FAIR.

NOTICE:—The JANUARY NUMBER of the

CORNHILL MAGAZINE

CONTAINS THE FIRST PART OF A NEW STORY

By D. CHRISTIE MURRAY,

ENTITLED

'RAINBOW GOLD.'

IN THE SAME NUMBER WILL APPEAR AN ARTICLE UPON CHARLES DICKENS,

WRITTEN BY HIS ELDEST DAUGHTER, ENTITLED

'CHARLES DICKENS AT HOME,'

WITH SPECIAL REFERENCE TO HIS RELATIONS WITH CHILDREN.

London: SMITH, ELDER and Co., 15, Waterloo Place.

DARLOW & CO.'S

IMPROVED PATENT **MAGNETINE** CURATIVE APPLIANCES

These Appliances are recommended and used by the Profession for the Cure of

Gout	Asthma	Chest Weakness	Sore Throat
Sciatica	Rheumatism	Spinal Affections	Heart Affections
Lumbago	Rheumatic Gout	Bronchitis	Liver Complaint
Neuralgia	Lung Affections	Winter Cough	General Debility

And every other form of Nervous and Rheumatic Affection.

TESTIMONIAL.—The Rev. J. CHARLESWORTH writes: 'Will you be good enough to forward one of your Chest Protectors? I have worn one during several winters with great benefit.'

LUNG INVIGORATORS.

25/-, 30/-, and 35/- each.

[Pamphlet Post-free.

DARLOW & CO., 443, WEST STRAND, LONDON, W.C.

NOW READY.

Sixth Natural History Reader.

240 pages, price 1s. 6d. Completing the Series of

ISBISTERS'

NATURAL HISTORY READERS.

By the Rev. J. G. WOOD, M.A., Author of 'Homes Without Hands,' etc.

Specially adapted to the Requirements of the New Code, and widely recommended by H.M. Inspectors. With Numerous Illustrations.

First Reader, 96 pp., cloth, 7d.	Fourth Reader, 288 pp., cloth, 1s. 6d.
Second Reader, 128 pp., cloth, 10d.	Fifth Reader, 256 pp., cloth, 1s. 6d.
Third Reader, 192 pp., cloth, 1s. 2d.	Sixth Reader, 240 pp., cloth, 1s. 6d.

*** *One of H.M. Inspectors* writes of them :—'I wish they were much more generally used, as I think the information contained in them of much greater value than that in the "ordinary" Reader, though at the same time I should not like to see the "ordinary" Reader wholly supplanted. Books as interestingly and accurately written as the Books in this Natural History Series cannot but be of great value.'

A Teacher writes of them in the *School Guardian* :—'They excite the children's curiosity and sympathy, are written in language well graduated according to the Standards, and *the children never tire of reading them.*'

Wm. ISBISTER, Limited, 56, LUDGATE HILL, E.C.

J. BOULTON & CO.'S (Limited), EDUCATIONAL PUBLICATIONS.

ADAPTED TO THE NEW CODE,

Chiefly by J. S. LAURIE, formerly H.M.I.

READING BOOKS AND CLASS SUBJECTS.

New Standard Readers. Primers I. and II. Books I. to VI.

Technical Readers. Introductory and Books I. to VI.

Our Country's Story. Historical Reader. 1s. 6d.

Manual of Practical Geography. 1s.

Manual of Arithmetic. 1s. With ANSWERS, 1s. 6d. Also in Parts for Standards.

Code Systematic Copy Books. 2d. each.

SPECIFIC SUBJECTS.

Elementary Algebra. 6d. ANSWERS. 6d.

Rudiments of Algebra, with ANSWERS. 9d.

Natural Philosophy, Latin and French Grammar, Animal Physiology, Botany, Magnetism and Electricity, etc. 9d. each.

Spencer's Practical Chemistry. New Edition. Just Published. Contains Tests for Bi., Ba., and Am. 1s. 6d.

Tots and Cross Tots. Just Published. 6d.

DEPOT FOR KINDERGARTEN MATERIALS.

CENTRAL SCHOOL DEPOT: 4, WORSHIP STREET, AND 12A, PATERNOSTER ROW, E.C.

MEMORY & SUCCESS.

WHAT contributes greatly to success?
A good memory.

WHAT always causes failure in life?
A bad memory.

WHAT is indispensable to every Lady and Gentleman, Student, Chemist, Physician, Merchant, Lawyer, Manufacturer, Farmer, etc.?
A good memory.

WHAT can every one obtain from PROFESSOR LOISETTE? A good memory—the Physiological Art of Never Forgetting—wholly unlike Mnemonics. *Any book whatever mastered in one reading.*

Prospectuses POST FREE, giving opinions of Mr. RICHARD A. PROCTOR, Dr. ANDREW WILSON, Clergymen and others who have studied the system.

Great inducements to Correspondence Classes in 'Never forgetting and for Cure of 'Mind-wandering' in all parts of the world.—Private Lessons—Day and Evening Classes—Lectures in Families of the Nobility and Gentry.

PROFESSOR LOISETTE, 37, NEW OXFORD STREET, LONDON.

A BOON TO ALL WHO HAVE TO SPEAK MUCH, OR READ ALOUD.

CROSSTHWAITE'S ESTBD. OCCULT 50 YEARS. LOZENGES.

FOR COUGHS, COLDS, INFLUENZA, BRONCHITIS, ASTHMA, WHOOPING COUGH, ETC., ETC.

May be obtained of all Chemists, in Boxes at 1s. 1½d. and 2s. 6d., Or post free from the Proprietors,

CROSSTHWAITE & CO., 73, Ludgate Hill, London, E.C.

Invaluable to Teachers. Now Ready, Price 6d.

THE QUEEN AND HER RELATIONS:

A New Series of Genealogical Tables, *bringing History up to the Present Day*, and showing, *inter alia*, the connection between our Royal Family and the Reigning Houses of Germany, Russia, Denmark, and Greece.

Sent post free for Six Penny Stamps.

HENRY G. DAVIES, KENSINGTON CHAMBERS, 73, LUDGATE HILL, LONDON, E.C.

EYRE & SPOTTISWOODE'S
MATHEMATICAL DRAWING INSTRUMENTS,
WATER-COLOURS, OIL-COLOURS,
And all Drawing Materials suitable for Technical and Art Students:
BEST TOWN-MADE DRAWING INSTRUMENTS,
As used in Public Schools.
EYRE & SPOTTISWOODE,
London—Great New Street, Fleet Street, E.C.

SCHOLASTIC MUSICAL INSTRUMENT CO.

(ESTABLISHED 1871),

To supply Teachers, School Board Members, and School Managers with ANY kind of Musical Instrument from ANY Maker at bona fide Trade Price for Cash, or by Easy Instalments.

Every one should read our Circular and Extracts, which are sent Post free.

Apply to the MANAGER, 39, Oseney Crescent, Camden Road, N. W.

'We have now had plenty of time to try the piano; and I can say to you how very much we are pleased with it, and how greatly I am obliged to you for procuring me so excellent an instrument so cheap.'—MATTHEW ARNOLD, Esq., H.M.I.

'You are at liberty to make any use of my wife's and my own opinion—that the piano is excellent both for tone and touch, and that it is a very cheap piano.'—Rev. T. W. SHARPE, M.A., *H.M.I. for Training Colleges for Schoolmasters.*

15,000 similar Testimonials have been received from all parts of the country, from H.M. Inspectors, Assistant Inspectors, Presidents of N.U.E.T., Principals and Masters of Training Colleges, Teachers and School Board Clerks.

THE ONLY ADDRESS IS

39, OSENEY CRESCENT, CAMDEN ROAD, LONDON, N.W.

SCHOOL DESKS.

Prize Medal awarded, International Health Exhibition, London, 1884.

GEORGE E. HAWES,

ONLY

SCHOOL DESK MANUFACTURER

IN

EASTERN COUNTIES,

MAKER OF THE

EAST ANGLIAN

AND

NORWICH DESKS,

SINGLE, DUAL, & CONVERTIBLE.

Special Infant Galleries with Desk and Seats combined for Kindergarten. Pupil Teacher's Desk with Seat attached.

For Particulars apply

STEAM JOINERY WORKS,
DUKE'S PALACE,
NORWICH.

Specimens at South Kensington Museum.

RE-ISSUE, in Twenty-four Monthly Parts, price SIXPENCE each, the Quarto Edition, of

THE GOSPEL TREASURY

An EXPOSITORY HARMONY of the FOUR EVANGELISTS.

PART I. ready early in December.
Specimen pages *post free* for one penny stamp.

Also Sixth Edition with FIFTY-FIVE Coloured Illustrations, cloth, gilt edges, 6s.

CHRIST AN EXAMPLE FOR THE YOUNG.

As Exhibited in the HISTORIES of the FOUR EVANGELISTS.

Each Picture has definitions and Exercises, and the 100 Lessons are fully worked out for Parents at Home or Teachers in the Class.

As a PACKET OF CARDS, 2s. 6d.

Now ready, Eighth Edition, in cloth boards, 2s.

THE SYSTEMATIC BIBLE TEACHER,

FOR HOME AND SCHOOL.

Also an *Advanced Edition*, with Third Grade Manual, 2s.

THE SYSTEMATIC BIBLE TEACHING MISSION DEPOSITORY,
67, PATERNOSTER ROW, LONDON, E.C.

Just published, small 8vo, 128 pp.

THE SHILLING GEOGRAPHY.

By Dr. MORRISON, M.A., F.R.G.S.

'Dr. Morrison has compressed a large amount of geographical knowledge into a very small space, without becoming obscure. A bright feature of the book is the introduction of sea trips round the coasts of the British Isles, and railway trips from the chief centres to various towns and places of interest.'—*Educational Times.*

'The book is very full of a valuable selection of facts. It is an accurate and well-arranged epitome of general geography.'—*The Schoolmaster.*

Also by the same Author,

THE HISTORICAL SCHOOL GEOGRAPHY.

368 pp., 3s. 6d. FOURTH EDITION, REVISED.

Specimens sent to Principals by the Author, 32, Abercromby Place, Edinburgh, on receipt of 8 or 21 stamps respectively.

LONDON: SIMPKIN, MARSHALL AND CO.

Tuition by Correspondence.

CERTIFICATE.—The preparation established in 1871 is available as usual. The following are the fees charged for correspondence twice a week :— Per quarter. By results.

Masters: First Year.....	15s.	...	£2
,, Second Year	21s.	...	£5
Mistresses: First Year	10s.	...	£1
,, Second Year.....	15s.	...	£3

Pupils who prefer the quarterly arrangement remit the fee at the end of the quarter. Those who select 'Payment by Results' are not required to part with any money for Tuition until a pass is recorded; and, if the pupil is unsuccessful after two attempts, the agreement will be cancelled without payment.

MATRICULATION (Established 1871), Science, Drawing, Scholarship, A.C.P., Civil Service, Diocesan, Shorthand, Musical, Medical, Legal, P.T. Papers, and other branches as advertised. *No payment unless successful.*

Address, JAMES JENNINGS and Co., Tuition by Correspondence Office, Deptford, London.

THOMAS LAURIE,

School Book and Stationery Depository,

31, PATERNOSTER ROW, E.C.

AGENT BY APPOINTMENT FOR THE SCIENCE DEPARTMENT.

Priced Catalogues of the following Departments may be obtained :—

SCHOOL BOOKS AND STATIONERY.
SCHOOL DESKS, BLACKBOARDS AND EASELS.
SCHOOL PRIZES OFFERED AT ONE-THIRD DISCOUNT.
SCIENCE APPARATUS AND DIAGRAMS IN EVERY BRANCH OF PHYSICS.
SCIENTIFIC CABINETS OF SPECIMENS.
ART MODELS AND EXAMPLES.
FURNISHINGS FOR SCIENCE AND ART SCHOOLS AND COLLEGES.
PURE CHEMICALS AND CHEMICAL APPARATUS AT WHOLESALE PRICES.
LAURIE'S TEACHERS' LIBRARY.
KINDERGARTEN TOYS AND OCCUPATIONS.
MAPS, GLOBES, AND PICTURES.

ALL GOODS GUARANTEED AND CARRIAGE PAID.

THOMAS LAURIE,

CONTRACTOR FOR THE SUPPLY OF ARMY SCHOOLS,

31, PATERNOSTER ROW, E.C.

THE want of a thorough good Lantern with first class Slides (not dauts), suitable for Presents, has long been felt, and we believe that we have adequately met the demand by our sets of

BIJOU LANTERNS AND SLIDES. These we offer at this special season at a remarkably low price, relying on an enormous sale to repay us. Every article throughout is of the very best make and finish. The demand for these sets last season was greater than we could meet. This year we have nearly doubled the quantity of pictures without making any alteration in price. These sets of Lanterns and Slides stand unrivalled for quality and cheapness. See them before buying if possible. We never fear the result of showing our articles; it always ends in purchase.—No. 1 set comprises best English Magic Lantern, brass front, slide-holder, rackwork lamp, and silvered reflector, set of Twelve Pictures, illustrating Views and Nursery Tale, sixty comic figures, two comic moving slides, two moving lever slides, two slides for Chinese fireworks, two moving panorama slides, and one revolving slide, Man Swallowing Rat, eighty-one pictures in all. Price all complete 10s. 6d. Shows a 3 ft. diameter picture on the screen.—No. 2 contains a similar assortment of slides to the above, only in a larger size and with a No. 2 Magic Lantern. Price complete 14s. 6d. Shows a 4 ft. picture on the screen.—No. 3, larger size. Very suitable for a special present. Price 21s. Shows a 5 ft. picture on the screen.—No. 4, a very superior set. Throws 6 ft. picture. Specially made for the present season, owing to the immense success of the three other sizes last year. Price 33s. No. 5, 50s.; No. 6, 70s.—Special Chemically Prepared Oil, 9d. and 1s. 6d. per bottle.

MAGIC CLOCKWORK MICE.—Either white or black. Best quality only. When wound up, run all about a room or table, causing roars of laughter and consternation. Post free, 14d. Rats, double size, 20d. Clockwork Cats, Dogs Lions, Tigers, Horses, Goats, Stags, Rabbits, Squirrels, Chickens, Ducks, and Tortoise, post free, 14 stamps each. Large Ducks, Horses, Omnibuses, Jockeys, Bears, Rhinoceroses, Carriage, Sheep, Lions, Tigers, Hyenas, Wild Dogs, Rabbits, or Cats. Post free, 20d.

THE MECHANICAL WALKING LADY.—Beautifully dressed. Will traverse all about a room or table in a most lifelike and graceful manner. Post free, 1s. 2d. Larger size, 2s. 9d. Largest size, 3s. 9d. Dolls of every description from 6d. to £4. Rag Dolls, 1s. to 8s. Wax Dolls, 1s. 6d. to £5. Dressed Dolls, 2s. to £8. Every description of Dolls' Furniture, Clothes, Dolls' Houses, etc., etc. See Catalogue.

THE INSULTING CIGAR CASE.—Directly any one tries to take a cigar they disappear, and in their place is an impertinent head, with its fingers to its nose. Post free, 1s. 2d.

CHRISTMAS CATALOGUE. over 400 Illustrations. Lanterns. Magical apparatus, amusements, etc.

E. P. THEOBALD & CO.,
BRITANNIA WORKS,
11, South Street, Greenwich, London, S.E.

ESTABLISHED 1851.

BIRKBECK BANK.—Southampton Buildings, Chancery Lane.

Current Accounts opened according to the usual practice of other Bankers, and Interest allowed on the minimum monthly balances when not drawn below £50. No commission charged for keeping Accounts.

The Bank also receives money on deposit at Three per cent. Interest.

The Bank undertakes for its customers, free of charge, the custody of Deeds, Writings, and other Securities and Valuables; the collection of Bills Exchange, Dividends, and Coupons; and the purchase and sale of Stocks and Shares. Letters of Credit and Circular Notes issued.

A Pamphlet, with full particulars, on application.

March, 1880. FRANCIS RAVENSCROFT, Manager.

The Birkbeck Building Society's Annual Receipts exceed Four Millions.

HOW TO PURCHASE A HOUSE FOR TWO GUINEAS PER MONTH, with immediate Possession and no Rent to Pay. Apply at the Office of the BIRKBECK BUILDING SOCIETY.

HOW TO PURCHASE A PLOT OF LAND FOR FIVE SHILLINGS PER MONTH, with immediate possession, either for Building or Gardening purposes. Apply at the Office of the BIRKBECK FREEHOLD LAND SOCIETY.

A Pamphlet, with full particulars, on application.

FRANCIS RAVENSCROFT, Manager.
Southampton Buildings, Chancery Lane.

CIVIL SERVICE.—Female Clerks, Men and Boy Clerks, Excise, Customs, etc. Candidates rapidly prepared through post on a thoroughly individual system. Fifty successes during 1883. Prospectus, containing list of successes, testimonials, etc., free on application to J. Keefe, F.R.G.S., etc., Civil Service Academy, Liverpool.

MR. HUGHES begs to announce that he has in the Press, and will publish early in January, 'CATCH QUESTIONS IN ARITHMETIC,' by the Rev. A. D. CAPEL, M.A.

NEW WORKS AND NEW EDITIONS,
PUBLISHED BY THOMAS MURBY.

IMPORTANT TO STUDENTS OF ELECTRICITY.

ELECTRICAL UNITS: Their Relation to One Another and to other Physical Units. With a Chapter on the DIFFERENT FORMS OF DYNAMOS, and a Series of NUMERICAL EXERCISES. Price 1s.

LECTURES ON MAGNETISM AND ELECTRICITY. By R. WORMELL, D.Sc., M.A Crown 8vo., 260 pp. Fully Illustrated. With copious hints as to the apparatus to be made and experiments to be performed. Price 3s.

A most simple and comprehensive work, assuming, on the part of the reader, at commencement, little or no previous scientific knowledge.

Uniform with the above.

LECTURES ON HEAT. By R. WORMELL, D.Sc., M.A. 80 pp., Crown 8vo, price 1s.

LECTURES ON SOUND. By the same Author. 112 pp. Crown 8vo, price 1s.

LECTURES ON HEAT AND SOUND. The two preceding works in one volume, price 2s.

ARITHMETIC FOR SCHOOLS AND COLLEGES. The most complete work on the subject, embracing over 7,000 Exercises. Large 8vo, 294 pp., 2s.; with Answers, 384 pp., 3s.

SHILLING ARITHMETIC. 224 pp. Selected from the above. Price 1s.; with Answers, 1s. 6d.

MODERN GEOMETRY. A Theoretical and Practical Course, based on Modern Methods. Revised by Professor Jack, New Brunswick University. Price 2s.

SOLUTIONS OF PROBLEMS IN THE ABOVE. Price 2s. 6d.

PLANE GEOMETRY. A Complete Course for Artisans. Price 3s. Solutions to ditto, 2s. 6d.

SOLID GEOMETRY. Price 2s. 6d. Solutions to ditto, 2s. 6d.

SHAKESPERIAN CHARACTERS DELINEATED. For the assistance of Students in Training Colleges and other Examinees in English Literature. By WILLIAM WEEKS, Senior Tutor and English Lecturer in the Exeter Diocesan Training College. Price 1s.

MURBY'S IMPERIAL COPY BOOKS.

"EXCELLENT." *Rapidly finding their way into all good schools.* "UNEXCELLED."

17 NUMBERS, PRICE 2d. EACH.

1. Half Text.	5½. Large and Small.	9. Small Hand.
2. Half Text.	6. Small Hand.	10. Small Hand.
3. Half Text.	6½. Double Small.	11. Small Hand.
¼. Large and ¼ Text.	7. Small Hand.	12. Small Hand.
4. Half Text.	7½. Three Hands.	12½. Ladies' Hand.
5. Small Text.	8. Small Hand.	

London: THOMAS MURBY, 3, Ludgate Circus Buildings, E.C.

DR. GENGNAGEL'S VIVA-VOCE SYSTEM.

A Practical Guide to German Conversation, bound, 3s.

A Practical Introduction to French Grammar and Conversation, 2s.

'Dr. Gengnagel's Method is no doubt the only one to secure fluent conversation. A rational method, creating a good colloquial style.'—*Schoolmaster.*

'We gladly recommend it to those who wish to learn or teach the language colloquially.'—*Educational Times.*

'Dr. Gengnagel seems to have solved a great problem. We confidently recommend his books.'—*United Service Gazette.*

'Dr. Gengnagel's plan seems to be the only truly efficient one to secure fluent conversation, and is well worked out by the author.'—*Broad Arrow.*

LONDON: SIMPKIN, MARSHALL & Co.

Mr. Bernays, one of H.M. Inspectors of Schools, says, in the new Blue Book:

'Our School Literature should contain such tales as those in HUGHES' STANDARD STORY BOOKS.'

Infants, 4d.

Standard	I. 6d.	Standard	IV. 1s. 0d.
,,	II. 8d.	,,	V. 1s. 6d.
,,	III. 10d.	,,	VI. 2s. 0d.

London: JOSEPH HUGHES, Pilgrim Street, Ludgate Hill, E.C.

THE BEST AID IN TEACHING GEOGRAPHY.

RICE'S PATENT MECHANICAL GLOBE.

Specially designed to illustrate the Alternation and varying lengths of DAY and NIGHT, the Succession of the SEASONS, and other Phenomena arising from the Diurnal and Annual Motions of the Earth.

Recommended by H.M. Inspectors and the leading educationists.

Price, fitted with Six-inch Globe of the best quality, ONE GUINEA.

☞ DETAILED PROSPECTUS ON APPLICATION.

LONDON:

GEORGE PHILIP & SON, 32, FLEET STREET.

APPROVED EDUCATIONAL WORKS.

By J. C. CURTIS, B.A.

A School and College History of England, containing copious supplementary Chapters on Religion, Constitutional History, Literature, Commerce, etc. 26th Thousand. Price 5s. 6d.
'A most admirable general narrative is given of political events.'—*Civil Service Gazette.*

A Short Manual of English History. With Genealogical Tables. 12th Thousand. Price 6d.
'One of the best summaries of English History which has yet been published.'—*Educational Times.*

Outlines of English History. 256th Thousand. Price 6d.
'As an introduction to English History we know of none equal to it.—*Quarterly Journal of Education.*

Outlines of Scripture History. 43rd Thousand. Price 6d.
'Concise, comprehensive, and well-arranged.'—*Church and School Gazette.*

An English Grammar for Schools. With numerous Exercises, Examples of Parsing, Analysis, etc. 22nd Thousand. Price 1s.
'The definitions are plain and exact, and the explanatory notes are most clear and forcible.'—*Schoolmaster.*

Outlines of English Grammar. With copious Exercises. 226th Thousand. Price 6d.
'Remarkably clear in its definitions, copious in its facts, and rich in the examples it gives for exercise.'—*Freeman.*

A Manual of Grammatical Analysis. With copious Exercises for Analysis and Composition. 78th Thousand. Price 6d.
'A very clear and excellent manual.'—*School Board Chronicle.*

A Manual of Etymology. 18th Thousand. Price 6d.
'Ably executed. The notes are especially valuable.'—*Educational Review.*

Outlines of Geography. 179th Thousand. Price 6d.
'A most excellent manual.'—*Court Circular.*

The Geography of Great Britain and Ireland. 16th Thousand. Price 6d.
'An excellent little treatise, which we can cordially recommend; it is full, accurate, and concise.'—*Educational Reporter.*

The Poetical Reader. 123rd Thousand. Price 1s.
'Just such a selection of spirited, genuine, and accredited ballads and pieces as we should wish our children to have at their tongues' end.'—*Patriot.*

The New Poetical Reader. 25th Thousand. Price 1s.
'We congratulate Mr. Curtis on having made so good a selection. It is sure to be a favourite wherever introduced.'—*National Schoolmaster.*

LONDON: SIMPKIN, MARSHALL, & CO.,
And all Booksellers in Town and Country.

JOSEPH HUGHES'S NEEDLEWORK ANNOUNCEMENTS.

Mr. Hughes begs to announce that a New Edition of Miss Jones's popular Manual on NEEDLEWORK AND CUTTING-OUT—which, owing to the great demand, has been reprinting—is Now Ready.

Now Ready, New Edition, crown 8vo, 3s. 6d. Specimen sent, post free, 2s. 8d. (P.O.O.)

PLAIN NEEDLEWORK AND CUTTING-OUT.

By EMILY G. JONES, Directress of Needlework to the Education Department.

With Original Plates and Illustrations, and a three-yards' sheet containing patterns, 'arranged so as to show the greatest economy of material.'

☞ *Miss Jones's Needlework and Cutting-Out is now the* **ACKNOWLEDGED STANDARD WORK** *on the subject, and will be found indispensable to Head-Mistresses and Teachers of Sewing.*

All Parts now Ready. Every Girl should have a Copy.

MISS JONES'S
SELF-TEACHING NEEDLEWORK MANUALS.

PROFUSELY ILLUSTRATED BY DIAGRAMS.

Standards I. and II., in one Book	Price	1d.
Standard III.	,,	1d.
Standard IV.	,,	2d.
Standard V.	,,	3d.
Standards VI. and VII., in one Book	,,	3d.

☞ *Complete Edition, in one Volume, for the convenience of Teachers, 1s.*

London: JOSEPH HUGHES, PILGRIM STREET, LUDGATE HILL, E.C.

NATIONAL SOCIETY'S PUBLICATIONS
FOR THE 1884 CODE.

New and Revised Editions of the English History and Geography Reading Books, in accordance with Circular No. 228.

ENGLISH HISTORY READING BOOKS.

(Illustrated.)

STANDARD II. 84 pp., 40 Lessons.—Introductory Tales from English History. By Miss YONGE, Author of 'Cameos from English History,' etc. Price 9d.

STANDARD III. 128 pp., 60 Lessons.—The Early History of England till the Death of Stephen. By Miss YONGE. Price 1s.

STANDARD IV. 156 pp., 61 Lessons.—The History of the Plantagenet Period. By Miss YONGE. Price 1s. 3d.

STANDARD V. 196 pp., 60 Lessons.—The History of Modern England from the Time of Henry VII. By Miss YONGE. Price 1s. 8d.

STANDARD VI. 224 pp., 60 Lessons.—History of the Customs, Manners, and Literature of the English People. By Miss YONGE. Price 1s. 8d.

The Young Student's English History Reading Book. 256 pp., 60 Lessons.—Being the Advanced Part of the 'English History Reading Books,' and consisting of a series of 'Pictures' of the more important facts of English History from the Earliest Times. Price 2s.

GEOGRAPHY READING BOOKS.

(Illustrated with numerous Maps and Pictures.) Arranged according to the Department Syllabus issued in the New Code of 1884.

STANDARD I. 80 pp., 40 Lessons.—Explanation of a Plan of the School and Playground, the four cardinal points, and the meaning and use of a Map. Price 8d.

STANDARD II. 100 pp., 40 Lessons.—Lessons on the Size and Shape of the World, Geographical Terms explained in simple language, and Illustrated by reference to the Map of England, and the Physical Geography of Hills and Rivers. Price 10d.

STANDARD III. 156 pp., 60 Lessons.—Physical and Political Geography of England, with special knowledge of the district in which the School is situated. Price 1s. 4d.

STANDARD IV. 196 pp., 60 Lessons.—Physical and Political Geography of the British Isles, British North America, and Australasia, with detailed account of their productions. Price 1s. 8d.

STANDARD V. 208 pp., 60 Lessons.—Geography of Europe, Physical and Political. Latitude and Longitude. Day and Night. The Seasons. Price 1s. 9d.

STANDARD VI. 224 pp., 60 Lessons.—Geography of the World generally, and especially of the British Colonies and Dependencies. Interchange of productions. Circumstances which determine climate. Price 2s.

SHAKESPEARE'S HISTORICAL PLAYS FOR SCHOOLS.

Edited and Annotated by CHARLOTTE M. YONGE, Author of 'The Heir of Redclyffe.'

1. **The First Part of KING HENRY IV.** With Frontispiece. 110 pp. Price 9d.
2. **The Second Part of KING HENRY IV.** 108 pp. Price 9d.
3. **KING HENRY V.** 135 pp. Price 1s.
4. **KING RICHARD II.** 128 pp. Price 1s.
5. **JULIUS CÆSAR.** 120 pp. Price 1s.

HISTORICAL BALLADS.

Arranged to meet the New Code of 1884, Schedule II., English.

Part 1 for STANDARDS II. and III. Edited and Annotated by Miss YONGE, Author of 'The Heir of Redclyffe.' 120 pp. Price 10d.

Part 2 for STANDARDS IV. and V. Edited and Annotated by Miss YONGE. 254 pp. Price 1s. 6d.

Part 3 for STANDARDS VI. and VII. Edited and Annotated by Miss YONGE. 286 pp. Price 1s. 8d.

The above Work complete in One Volume, handsome binding, gilt edges, price 4s.

NEW NATIONAL ARITHMETIC.

New and Revised Edition adapted to the requirements of the New Code of 1884.

Part First. (Including Standards I. and II.) Price 3d.
— **Second.** (Standard III.) Price 2d.
— **Third.** (Standard IV.) Price 2d.
— **Fourth.** (Standard V.) Price 2d.
— **Fifth.** (Standard VI.) Price 2d.
— **Sixth.** (Standard VII.) Price 2d.

Key—Part I. Containing Answers to the Questions in Parts I., II., III., 4d. each.

Key—Part II. Ditto, Parts IV., V., and VI. Price 4d. each.

Parts together, with Keys, do. Price 1s. 4d.

BRITISH MUSEUM 10FEB85

CHAPTERS IN POPULAR NATURAL HISTORY.

Being an advanced Reading Book for use in Elementary and Higher Schools. By Sir JOHN LUBBOCK, Bart., M.P., F.R.S., Author of 'Ants, Bees, and Wasps,' etc. With 90 Illustrations. 224 pp. Price 1s. 6d.

The above work in handsome binding, gilt edges, price 2s.

READING BOOKS ON THRIFT.

1. **The Social Economy Reading Book** (for the Upper Standards); being a Series of Easy and Attractive Readings on Social Economy. By the Rev. W. L. BLACKLEY. Price 2s.
2. **The Political Economy Reading Book** (for the Upper Standards), being a Series of Easy Readings on the more Elementary and Popular Subjects of Political Economy. By R. H. INGLIS PALGRAVE. Price 2s.

The NEW NATIONAL READING BOOKS

(Illustrated.) Adapted exactly to the New Code of 1884.

INFANT PRIMER.	32 pp., cloth limp.	Price	2½d.
INFANT READER.	64 ,, ,,	,,	4d.
STANDARD I.	112 pp., cloth boards	,,	6d.
STANDARD II.	128 pp. ,, ,,	,,	9d.
STANDARD III.	192 pp. ,, ,,	,,	1s.
STANDARD IV.	288 pp. ,, ,,	,,	1s. 6d.
STANDARDS V. and VI.	352 pp., cloth boards.		Price 2s.

BOTANY READING BOOKS.

By the Rev. A. JOHNSON, M.A., F.L.S., Head Master of St. Olave's Grammar School.

Part I. Vegetable Life. Illustrated from Plants easily met with. The more permanent organs. Illustrated. Price 1s.

Part II. The Different Orders. Distribution of Plants. Anatomy and Physiology of Plants. With 25 pages of Plates. Price 1s. 8d.

National Society's Depository, Sanctuary, Westminster.